A PRACTICALL ABSTRACT

Of the Arts, of Fortification and Assailing.

Containing Foure different Methods of Fortifications, with approued rules, to set out in the feild, all maner of superficies, Intrenchments and approches, by the demy Circle, or with lines and Stakes.

Written for the benifit of such as delight in the Practise of these Noble Arts.

By Dauid Papillon Gent.

I haue diligently perused this Abstract: and do approue it, well worthie of the Publick view.

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PLVS GLADIVS, QVAM SCEPTRA VALENT.

THOMAS FAIRFAX.

Generalis exercitus Anglicani
Miranc tacitus, fatagque vergant vide.

IN ANAGRAMMA.

Ferri-Fax erit *hæc patriæ* Famosa, *salutem.*
Civibus ense suis exitiumve ferens.

TO HIS EXCELLENCIE,

Sir THOMAS FAIRFAX,

Generalliſime of the Forces of the honourable Houſes of Parlement.

Excellentiſime,

IF *the ſubject of this Abſtract were rightly conſidered, it would appeare to all ingenious ſpirits, that the dedication of it doth properly appertaine to your Excellency, as the moſt experienced Commander in the Art of Warre, of all theſe Northern parts, as it may appeare by your Martiall atchievements; having, like a lightning, paſt this Summer from the North part of this Kingdome, to the utmoſt point of the Weſt of it; throwing downe, like a rapid Torrent, the banks that did endeavour to ſtop his courſe: and therefore the better able to judge aright of the benefit that might redound to the State, if theſe Methods of Fortifications were obſerved in the Works of our Garriſons; and theſe field * intrenchments, and double intrenched Camps here deſcribed, were uſed in all our formidable ſieges and pitcht battells; the neglect of which hath been one of the maine ſecondary Cauſes of the ſpinning out of this unnaturall Warre.*

* The Arts of Defence and Aſſailing are two of the moſt eſſentiall parts of the Art of VVar.

But ſince it hath pleaſed God to raiſe you to that emi-

nency of place, that affords you power to rectifie these defects; I have presumed to tender to your Excellency these essayes, containing some approved directions, for the future, of the Works of our Garrisons; and for the double intrenched Camps, that we are of necessity to make use of, if we intend to give (by the gracious favour of God) a speedy and a blessed period to the miseries of this poore and desolated Kingdome.

* The neglect of these intrenchments is to be rectified.

If I were not assured that you are extraordinarily well versed in the ancient and moderne Histories, I should endeavour by manifold instances, to perswade you to be the restorer (in these Northerne parts) of the Military Discipline of the ancient Romans, and of the field-intrenchments, and double intrenched Camps, whereby * Cæsar made himselfe the absolute Monarch of the world, as Maurice Prince of Orange was the restorer of them in the Netherlands, to his eternall fame. For certainly, it is the onely meanes, after Gods favour, to conduce these civill distractions to a speedy and a blessed accommodation: but being confident that these things are familiar to you, I will refer them to your judicious consideration; and onely beseech you to be pleased, out of your gracious affability to all men, and particularly to my selfe, to be the *Mecœnas to these Essayes, and to accept of them with the like affection, as Artaxerxes the great King of Persia received two hands full of fresh water, that were presented unto him by a poore Subject of his, for want of a better gift to expresse his love: So shall I for ever be obliged to remaine

* See Cæsars Commentaries in the warres of the Gaules and of Africa.

* Mecœnas was the Emperour Augustus Cæsars favourite, and the Patron of learning.

From London, Jan. 1.
1645.

Your Excellencies most humble,
and devoted Servant,

DAVID PAPILLON.

To the Reader.

SOme will conceive this time unſeaſonable for the publiſhing of this Abſtract, becauſe of the proſperous ſucceſſe of our Armies this ſummer, and therefore (ſay they) it were more ſeaſonable to write of razing to the ground our old Garriſons, then to write of directions to erect new: I anſwer, that I wiſh their conceits ſhould prove reall truths, for although I write of two of the moſt eſſentiall parts of the Art of Warre, yet I daily pray and wiſh that all the Inland-Garriſons in this Kingdome were razed to the ground, that his ſacred Majeſtie might the ſooner returne in love and peace to his moſt loyall Parliament. But when I conſider, that the virulency of the humour of a Civill Warre is like a canker in a womans breſt that never gives over the ſucking of her blood, till by her death he ſlay himſelfe; and that the two parties of all civill warres, may be compared to a couple of tenni's-ball players, that have ſometimes the beſt, and ſometimes the worſt, one after another, and that they that doe rely over much upon their advantage, doe commonly loſe the game, I diſ-aſſent in judgement with theſe imaginarie conceits.

Firſt Conſideration.

Second Conſideration.

For as a wiſe and learned Phyſitian can partly gheſſe by the ſymptomes of the diſeaſe of his patient, whether his ſickneſſe will be of a ſhort or long continuance, even ſo ingenious ſpirits, may partly gheſſe by theſe inſuing ſymptoms, viſible to all men, that the dangerous maladie of this unnaturall warre, is not yet near her criſe.

The evidences that ſignifie our miſeries are not yet come to their laſt period.

Firſt, by a generall antipathie that continues ſtill in the inclination of men.

The ſymptomes of the generall maladie.

Secondly, by the Hereſies, Sects and Schiſmes that rent and make greater breaches in the Church, then ever was knowne ſince Queen *Maries* daies.

Thirdly, by the great obſtinacy of ſuch as would ſeem more holy, then their Brethren, and yet preferre their own ends before Gods glorie, and the unitie and concord of the Spouſe of Chriſt.

Theſe dangerous ſymptomes, I ſay, are evident ſignes that Englands miſeries are not yet neare to their higheſt period, yet Gods waies are not like our waies, for hee can when he pleaſeth, draw light out of darkneſſe, and deliverance from things that ſeem moſt deſtructive to his Church.

As concerning thoſe that conceive the publiſhing of this Abſtract unſeaſonable at this time, and would have us becauſe of this ſummers proſperous ſucceſſe caſt our ſelves in the bed of a carnall ſecuritie, I will prove by two inſtances that there is nothing more dangerous then to rely upon proſperous events, and upon our owne parts and activitie.

* See *Plutarch* in his diſcourſe of the Olimpian Games.

1 It is recorded that *Attelante* running the race in the * Olympian games, did ſo relye upon her activitie, that ſhee took up twice one after another in her race, two golden balls, that her Antagoniſt did caſt downe to retard her ſpeed; and notwithſtanding recovered her ground: but the third ball being caſt, as it ſeemes, too neare the end of the race, ſhe loſt by the taking of it up, the Crowne of honour due to the Victor: whereby it appeares, that conſtancie in all things carrieth the bell away.

* See *Hannibals* Life, and *Titus Livius* Decads.

2 When * *Hannibal* did run the race againſt the Romans, for a Crowne of no ſmaller value then the Empire of the whole world, he was after the three famous victories obtained againſt them, at the river Trebie, at the Lake of Traſymeine, and at Cannis, in greater probabilitie to obtaine the Crowne hee ran for, then wee are at this preſent to obtaine the Crowne of the race of this unnaturall war. And yet by theſe defects; 1 By relying over-much upon his former ſucceſſe; 2 By neglecting his advantages; 3 By caſting himſelfe in a bed of carnall ſecuritie in Capua, in ſtead to advance towards Rome with his Army, he loſt not only the Crowne hee ſtrove for, but alſo his life and Common-weale.

Theſe conſiderations and inſtances paſt, and theſe motives following, have therefore induced me to publiſh this Abſtract.

1 To procure the common ſafetie.

2 To

2 To rectifie the deformities of our Fortifications.

3 To enlighten the meaneſt capacities, that delight in the practice of theſe Arts.

For the firſt, it is certaine and knowne to all men, that the inſufficiencie of the works of our Garriſons, hath been the ſecondarie cauſe, that divers of them have been loſt ſuddenly, and their Inhabitants brought to penurie. To prevent this evill for the future, I propoſe to our Counties foure different methods of Fortifications, that they may make choyſe of the moſt ſuitable to their meanes and abilities, aſſuring them that the meaneſt of theſe foure Methods is ſtronger and ſafer then their Mounts and winding Angles; ſo they obſerve the dimenſions deſcribed here for everie one of them.

For the ſecond, the deformitie of our Works is ſo great, and the errours in the ſetting out of them ſo groſſe, that they ſerve only as an object of deriſion to Forrainers that ſee them: And theſe errours proceed from a ſelfe-conceitednesſe inherent in ſome men of theſe dayes, that preſume to have skill in thoſe things, in which they have no skill at all; for the moſt mechanicall Artificers and Shop-keepers will be meddling with the ſpirituall Function, and controll Enginiers. And ſome Divines, in ſtead to feed their flocks, do take upon them to be Sub-Committees of the fortifications of a Garriſon. And theſe diſorders are permitted by the over-frugalitie of ſome Committees, to ſave an Enginiers pay: a deſtructive frugalitie to themſelves, and to a whole Countie, as ſome have found by lamentable experience. Now to avoyd theſe errours for the time to come, I have in this Abſtract ſet downe (without reſervation) the proportions and dimenſions they are to obſerve, and from whence they are to draw the Lines of their Flanks, and of their Line of defence to be convenient for the Cannon and Musket-ſhot, without which obſervations no Fortification can be good, or ſerviceable.

For the third, the Theoricall writings of Mr. *Ward*, Mr. *Cruſo*, Mr. *Norwood*, and of the Author of the *Enchyridion*, have rather encreaſed the ignorance of meane capacities, then their knowledge in the practice of theſe Arts: For I have converſed with ſome, that had all their rules upon their fingers ends, that could not ſet out a Superficie in the field to any purpoſe, and that is the reaſon

reason why I write more plainly then they; or that I should otherwise have done, if it had not been to enlighten the meanest capacities, that delight in the practice of these noble Arts. Therfore if these Essayes of mine may any way be profitable to thee, I shall attaine to my wished end: If not, accept however my good will, since I can neither offer nor give more then I have received from above. And so committing thee to the gracious protection of God, I desire to rest

From London the first of January, 1645.

Thy servant in the Lord,

David Papillon.

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Chap. I.

Of the true Character of a compleat Enginier.

AS the bleſſed ſucceſſe of an Army depends (after the favour of God) upon the election of a wiſe and valiant Generall; ſo doth the ſufficiency of the works of a Gariſon depend upon the choice of a skilfull Enginier. And the want of this choice hath been hitherto the eſſentiall cauſe, that few or none of our Gariſons have been fortified, as they ought to be; and why divers of them have been loſt in eight and fourty hours. Therfore to prevent this evil for the future, I intend, in the firſt place, to ſpeak of the qualities required in a good Enginier, That the Committees of our Gariſons, to whom this choiſe appertaineth, may be informed of them, to the end, they may hereafter be more circumſpect in their election.

1. He is to be religious; for [b] *the fear of the Lord is the beginning of wiſdom.*

[b] Eccleſ. 2. 15.

2. He is to be a ſouldier; for none can better judge of the ſufficiency or inſufficiency of Fortifications, then they that have learned from their youth to defend, and to take them.

3. He is to be a traveller; for he that hath not ſeen variety of works, and the excellency of forreign Fortifications, cannot perceive the defects of ours, nor give directions to rectifie them.

4. He is to be well verſed in the Arithmetike for his calculations; in the Geometry, for the ſetting out of all ſuperficies; in the Architecture, for to direct all manner of artificers; and in the o-

ther parts of the Mathematikes, for the taking of distances, depths, and elevations, and for the inventing and the contriving of all manner of Engines and machines of warre.

5. He is to be wise in all his proceedings, punctuall in all his promises, carefull and diligent in his calling, and rather enclined to austerity then lenity, or otherwise he will never be respected, served or obeyed.

6. He is to be of a solid judgement, and quick of apprehension, to judge aright of the defects and advantages of places, of raising grounds, or hollows that may endanger, or command a place committed to his trust, and what kinde of method of Fortification is most convenient for it; and which method, among the rest, requires lesse men to man the works; or to judge of the weakest places of a Garison, if he be desired by his Generall to goe with him to besiege a Town, advising him where he is to begin his approaches, plant his batteries, where he is to erect his bridges, if there be a river running of one side, or in the midst of the Town, and how the line of communication is to be drawn to secure his bridges; and what redoubts or flankers are required to fortifie his Camp. He is not to give account of his actions to any, but to the Generall, or to the lieutenant Generall of the Ordnance; if he be in an Army, or in a Garison, only to the grand Committee, and to the Governour; and as for all other kinde of men, inhabitants, souldiers or officers; he is not bound to expostulate the case, if they demand of him reasons for any thing he directs or commands to be done; neither ought he, if he regards his reputation, and makes conscience of his ways, to comply (when he is called to a Councel of war, or before a full or whole Committee) with the humour of the greatest in authority, or be led to assent to any resolution, that is against the maxims of his Art, by the Logical and Sophisticall reasons and arguments of Scholars or Church-men; for some of them are now a dayes over-busie in things that go beyond their element, and endeavour to over-sway Artists by rhetorike, considering not that their reasons are no reasons at all to the reasons of art. And this last quality is the essentiall part of a good Enginier; for all the other are but to small purpose without this.

CHAP.

Chap. II.

Of the Antiquity of the Art of Fortification.

The antiquity of this Art may be derived from the time of *Nimrod*[c], for the Tower of *Babel* was an admirable ſtructure, or Fortification, & from that time it came to a higher degree of perfection in the dayes of *Ninus* and *Semiramis* his Queen, that erected the incomparable Rampiers, and unparallel'd Towers, that did begirt the great City of *Babylon*, that were of ſuch an incredible ſtrength, height and breadth, that[d] *Cyrus* when he beſieged the ſame, durſt not attempt to aſſail it on the Land ſide, but was enforced to drain the great river of *Euphrates*, into ſmall chanels by the irkſome and indefatigable labour of his great Army, and ſo entred the ſame the very night that King[e] *Belſhazzar* was carouſing with his Princes, wives and Concubines. We read alſo that[f] *Vejente* was ſo ſtrongly fortified, in the ſecond century of years after the foundation of *Rome*, that the *Romans* could not have reduced the ſame in ten years ſiege, if *Furius Camillus* their Generall had not invented, at the later end of the tenth year, the Art of mining, by which means he took the ſame, by breaking in the middle of the City with his mine, while a generall aſſault was given by his Army, to draw all the ſouldiers and inhabitants of the City to man and defend their Rampiers. [g] *Tyrus* alſo was ſo ſtrongly fortified in *Alexander* the greats dayes, that his Army durſt never aſſail their works on the Land ſide, but were enforced after three years ſiege to erect a Mole, over a bay of the ſea, of an incredible ſtructure, whereby it was reduced, becauſe the ſea-ſide was not fortified. *Syracuſe* alſo was ſo admirably fortified, that[h] *Marcellus*, a rare and valiant Generall of the *Romans* with a great Army could not reduce the ſame in two years ſiege, and had never taken it, if *Archimedes*, the rareſt Enginier and *Mathematician* that ever was, had not preferred the compleating of a *Geometrical* demonſtration before his own life, and the preſervation of his Countrey. [i] *Demetrius* alſo king of *Macedonia*, with a great Army, and all his admirable Machines of warre, could never make a ſufficient breach in the Rampiers of *Rhodes*, but was enforced to raiſe his ſiege

c Gen. 11, 4, 9.

d See S *Walter Rawley* Hiſtor.

e Dan. 5. 3.

f See *Titus Livius* in his Decade. 1.

g See S *Walter Rawley* in his hiſtory of the world.

h See *Plutarch* in *Marcellus* life.

i See *Plutarch* in his life.

from before it, because of the impregnable Fortifications of it, but it flourished specially, and attained to the highest degree of perfection, that ever it was before: and since that time in * *Cæsar* and *Titus* daies, as it will appear in the next Chapter, when I shall come to speak of the siege of *Alexie* in *France*, and of *Jerusalem*. Therefore I doe not a little wonder, that a Gentleman so well read in Histories as Mr *Ward* was, should disagree from the opinion of the greatest Commanders that have lived in our dayes, by maintaining, as he doth in his [k] Animadversions of war, that we excel, in this Age, the Ancient in the Art of Fortification and assailing. But this errour proceeds by the comparison he makes between the Fortifications that were erected in Christendome, some century of yeares after the *Goths* and *Vandals*, that had overrunne the greater part of it, and by their barbarous dispositon, had destroyed all the ancient monuments, and over-cast by their burning of all books of Sciences, a cloud of ignorance over all the face of Christendom: and therefore to make good his opinion, he should have taken his comparisons from the flourishing times of the *Greeks* and *Romans*, as I will shew in another place.

* See *Cæsars* Comment. and *Iosephus* histoire.

[k] See from p. 50 to 60.

Chap. III.

Of the Nations that have excelled, and doe excell at this present time, all other Nations in the Art of Fortification.

IT is certain that the *Caldeans*, *Jews*, *Greekes*, and *Romans* have anciently excelled all other Nations in the art of Fortification and assailing: And that the *Italians*, the *French* and the *Hollanders*, do at this day excell all others in these Arts. M. *Ward* in his Animadversions of warre, is pleased to give the precedency to the *Hollanders*; yet I know no reason for it, except it be to honour that Nation, where he exercised his *Militia*. For if the *Hollanders* excell these two former Nations in their out-guards, they do as much excell them in their inward works; and all Engineiers know, that the inward works are the essentiall parts of the

the Art of Fortification. And yet of late years Sr *Anthony de Ville*, and *Honorat de Meynier*, two of the laſt *French* Kings Enginiers, have gotten in my opinion the ſtart of the *Hollanders*, for out-works, and avant-guards alſo. Notwithſtanding they have the moſt convenient ſoil for ſuch works, of any Nation in Chriſtendom, becauſe twenty Pioneers in *Holland*, will do more work in one day, then threeſcore can do here in *England*, *France*, or *Italy* in two dayes, for the evenneſſe of their ſoil, the tenderneſſe of their ground, and their plenty of turff. But if the precedency in theſe Arts belong to any of theſe three Nations, it appertains really to the *Italians*, for *John Baptiſt Zancke*, *Caſtriot Durbin*, *Francis Montemeillino*, *Lorini Florentine*, and *Peter Sardi* a *Roman*, and divers other *Italian* Enginiers, ſome of which comming with the Duke of *Parma* into the Low-Countries, infuſed in the *French* and the *Hollanders*, what they know of theſe Arts, for they were the firſt that revived and adorned them, after they had been buried for divers centuries of years, in the grave of oblivion, by the inhumanity of the *Goths* and *Vandals*. I do not here place the *Spaniards* and *Germans*, to ſtand in competition with theſe three Nations, becauſe the greater part of the beſt Fortifications in *Germany* and *Spain*, have been lined out and ſurveyed by *Italian* Enginiers. Now, whether our modern Fortifications do excell the Fortifications of the ancient *Caldeans*, *Jewes*, *Greeks* and *Romans*, it cannot be decided, becauſe theirs are deſtroyed, and ours extant; except we refer our ſelves to the teſtimony of the ancient Hiſtorians: which, if we do, M. *Wards* poſition, ſpoken of in the laſt Chapter, is abſolutely overthrown. For although I have ſeen in my travels, the greater part of the rareſt and ſtrongeſt holds in Chriſtendom, yet I muſt ingenuouſly confeſſe, that I have ſeen none to be compared to the Towers and Rampiers of *Babylon*, to the Fortifications of *Vejente*, *Syracuſe*, *Tyrus*, and *Rhodes*, but eſpecially, to the Cittadel of *Antonia*, and the three Towers, and the Rampiers, that *Herod* the great built in *Jeruſalem*, in commemoration of his wife, brother and intimate friend. And as for the Art of aſſailing, that goeth hand in hand with the Art of Fortification, as two inſeparable Twins or Companions; all judicious men know, that as the one increaſeth in degrees of per-

fection, ſo doth the other, becauſe if new inventions be found to fortifie places, more ſufficiently then one could formerly, the ingenious ſpirits of great Commanders have no reſt, till they have found new waies of aſſailing to reduce them. For inſtance, the invention of baſtions and motes of fourſcore, or of a hundred foot broad, and thirty foot deep, full of water, was no ſooner found out, but *Gerard* a *French* Enginier, that was in the ſervice of the Prince of *Orange*, found the invention of our Galleries, whereby theſe large and deep motes may be paſſed without danger, and mines made to blow up the baſtions. Whereby we may conclude, that if the ancient did excell us in the Art of Fortification, they did alſo go beyond us in the art of aſſailing. Now to prove that they did excell us in them both; we are, 1. To examine what modern Fortifications are extant, that may be compared to the ancient Fortifications before cited. 2. In which of all our modern ſieges, there hath been more art and induſtry ſhown, then at the ſiege of *Alexia*, and of that of *Jeruſalem*? But becauſe this point may more properly be decided, when we ſhall have occaſion to ſpeak of the art of aſſailing; I will paſſe it over at this time, to examine another poſition of *M. Ward*, that maintains, our Ordnance to be more powerfull then the great Machines of war of the ancients; and upon this infers, that of neceſſity our Fortifications muſt be ſtronger then theirs were, becauſe ſome of ours can hold out againſt the thunder of our roaring Cannons. Miſtake me not, I do not ſpeak of the Fortifications of this Kingdom, for I know never a Gariſon of ours, whoſe works are only of Cannon-proof, but of the beſt forreign Fortifications. I acknowledge that the great Machines of war of the ancient where more comberſome to mannage then our Cannons are; but that our Cannons be more powerfull then they were, it doth not appear to be ſo, by the teſtimony of the ancient Hiſtorians. For the great Rams of the *Romans*, made great and ſufficient breaches to come to an aſſault, in the ſtrong Rampiers and Towers of the Cittadell of *Antonia*, and in *Herods* Towers, that were built, ſaith *Joſephus*, of hard free-ſtones of an incredible thicknes; againſt which, a battery of ſix of our Cannons could not have moved one of them. And in liew of our muskets, they had balliſters that were more powerfull, wherwith they kept the

the defendants in such awe, that they durst not peep out thorow the port-holes of their battlements. It is therefore most certain, that the ancient *Greeks* and *Romans*, have not only excelled us, in the Art of Fortification and assiling, but also in divers other Arts; as in the Art of graving, of painting, of sculpture, of architecture, and in all the parts of the Mathematikes, and in the very art of warre. And as for the power of their Machines and ballisters, it was also greater then that of our Cannons, and of our musket-shot; only they were, as I have said before, more combersome, because their great Rams required two hundred men to mannage them, and their ballisters four or six men: and six Cannoniers with their six mates, and four and twenty matroses, will mannage six Cannons mounted upon a plat-forme, and every one of our souldiers can mannage a musket; and notwithstanding this advantage, they excelled us in the art of warre.

Chap. IIII.

Of the true use of the Art of Fortification.

This Art was invented at the first, to preserve a handfull of men against the oppression and cruelty of a multitude; for according to the rules of it, a Garison Town is not sufficiently fortified, except one hundred men within it, can oppose a thousand assailants without; and a thousand, ten thousand, that is, one defendant against ten assailants; but it is with this caution, that the place besieged be provided with a competent number of men, ordnance, ammunition, arms, victuals, and a Magazine furnished with all manner of fire-works, morter-pieces, engines of warre, ladders, and pioneers tools; for if any of these necessaries be wanting, this Garison will not subsist against a lesser number, then is here spoken of. But the Committees and Governours of our Garisons, are for the greater part so careless of these things, that few or none of our Garisons are provided of victuals for a moneth, and of ammunitions, arms, fire-works, ladders, and pioneers-tools, so sleightly, that the first assault would deprive them

them of all their ſtore: nay, I have been in a Gariſon ſo ill provided, that in their timber-yard, there was not ſo much good timber, as to make a draw-bridge, nor a ladder, nor barrows to be had, when occaſion did require to uſe them, but was enforced to ſtay while they were made. Now how ſuch a Gariſon could ſubſiſt againſt an active army, if it were beſieged, I leave it to the judicious Reader to judge of it. But our enemies are more provident, witneſſe the long reſiſtance of *Baſing*, of *Latham*-houſe, of *Carlile*, of *Skipton*, and *Scarborrow*-Caſtle, and now of *Cheſter*.

2. It was invented to preſerve a ſmall Army in the field, againſt a great and powerfull army, or of an army againſt three armies. As *Cæſar* did preſerve himſelf, and the ſmall army he had with him in *Africa*, againſt the three powerfull armies of King *Juba*, of *Scipio*, and of *Labienus*; and by his great experience in this Art, did overthrow them all, more by the ſpade and pickax, then by his ſword. And one of the main ſecondary cauſes of the ſpining out of this unnaturall warre, hath been, that our Commanders in chief have neglected to make uſe of this noble Art, that *Cæſar* himſelf did not diſdeign to practiſe; for he often lined out the intrenchments of his own Camp, and would draw upon paper the models of the Forts, or Engines of warre, that he would have his Enginiers to ſet out, and have made. And for the erecting of bridges over [m] Rivers, and raiſing of high mounts and plat-forms to place high wooden Towers, and his Machines of warre, he excelled all his Enginiers, as may be ſeen in his Commentaries, by the ſtrong and ſtately bridge that he erected over the *Rhine*, when he paſt over into *Germany*, which bridge he fortified with four Forts, and rare intrenchments, to ſecure his return into *France*, leaving for the defence of them one of his Legions, and for the raiſing of incredible Towers, Mounts and Plat-forms, and for the ſetting out of an intrenched Camp, with a double line of Communication, I will referre the Reader, becauſe I ſhall have occaſion to ſpeak of it in another place, to the ſiege of *Alexie* in *France*, where we may ſee his admirable induſtry and skill in this Art. But we have ſhamefully been inforced ſundry times to raiſe our ſieges for want of an intrenched Camp, as at *Newark*, *Dudley* Caſtle, *Pomfret*-Caſtle, *Banbury*-Caſtle,

l See *Cæſar* Comment. of the warre of *Africa*.

m See *Cæſar* Commentary in the warres of *Gaul*.

Caſtle, and Dennington-Caſtle, and in all theſe by an handfull of men; whereas if we had be o in an intrenched Camp, an Army ſix times as great could not have forced us to a retreat. Therefore to beſiege Towns or Caſtles of any moment, without an intrenched Camp, except we come to a generall and furious ſtorme, the next day after our Army hath faced the ſame; it is properly to ſpin out this war wittingly; and for to receive rather an affront, then to obtaine a victorie, or honour and reputation.

3. It was invented to erect ſtrong holds upon the Frontiers of a State or Kingdome, to prevent the incurſions of a forraine Enemy, that might with a great Army, come like a roaring floud, that throwes downe all the river banks, into the verie heart of a Kingdome, without oppoſition, and by meere activitie conquer the ſame; as the Duke *D'Alva* conquered for the King of Spain, as unjuſtly as ſuddenly, the Kingdome of * Navar, under pretext to paſſe thorow that Kingdome, to go againſt the French King, then in Languedock. And the eſſentiall cauſe of this great loſſe came by the negligence of the King of Navar, that had not provided, as he ſhould have done, with men, Ammunition, and victualls, his Frontier Garriſon Townes.

* See the Hiſtorie of Spain in *Ferdinand* and *Iſabels* Raigne.

4. It was invented to preſerve mens habitations, and the Suburbs of Corporations, and not for to burne, or pull them downe, as many of our Enginiers have done in theſe dayes, to their ſhame and guilt of conſcience. For if an Enginier, to comply with thoſe in authoritie, or with the ſelfe-conceited men of a Garriſon, aſſent to pull downe Suburbs, or ſmall Hamlets that are joyned to their Corporations, except they are ſuddenly and certainly in danger of a Siege, it argues that hee is either unskilfull in his profeſſion, or voyd of all Chriſtian charitie, and naturall humanitie; for by the experience of his Art, or alteration of his method of Fortification, he may preſerve theſe Suburbs or Hamlets, to the great advantage of the Town; or of another Fortification, and ſo diſpoſe of his works, that he may ſecure them, and yet the Corporation ſhall rather need fewer men to man their works, then it would require when theſe Hamlets are pulled downe. This hath been the caſe of Leiceſter, for had they not rejected a good counſell, they might aſſuredly have been preſerved by a larger Line of Communication, then there was by halfe a mile; for this Line

might have been defended with three hundred men leſſe then that they made, for the which they were enforced to pull downe many honeſt mens houſes, and draw a true imputation of inhumanitie upon themſelves; for what greater inhumanitie could theſe poore ſoules expect from their cruell Enemies, then to ſee their houſes burned, or pulled downe. And by this inſtance you may ſee how dangerous it is for Committees and Governours to be led away by the chat and ridiculous reaſons of ignorant and ſelfe-conceited men, that make no conſcience what miſchiefe they do to others, ſo they ſecure themſelves, as they ſuppoſe; for it is often rather a ſuppoſition, than a true ſecuritie or preſervation, becauſe it falls out oftentimes, that if theſe Hamlets or Suburbs be fortified, they ſerve as Bulwarks for the preſervation of their Towne, and ſo by pulling downe of them, they advance their owne ruine, to ſave ſome ſmall charges; nay, they often encreaſe them, by pulling of them downe. For inſtance: It is ſuppoſed by the judgement of ſuch men afore-mentioned, that Cotton End, a ſmall Hamlet adjoyning to the South bridge of Northhampton, is to be pulled downe, if they be threatened of a Siege, to make the circumference of their Works the leſſe, and to ſecure their Bridge. But I will maintaine that if Nature it ſelfe, and the Art of man had plotted together, to place a commodious ſeat to ſerve as a Bulwark, not only to the South bridge, but to the whole Towne, they could not have found out a better then that part of Cotton End is. For being fortified as it ought to be, it will make that ſide impregnable; and this End might have been fortified and ſecured at the firſt, with ſmaller charge and a ſhorter Line of Circumference, then that which they have made, by which it is expoſed to the Enemies mercie, and yet their Works are by it of leſſe validitie, if they had not relyed over-much upon their owne judgement.

And although this conceit is backt with the aſſent of a learned Divine, yet I will judge charitably of his aſſent, as being in judgment ſo poſſeſt, this being out of his element; yet wiſdome ſhould induce him to rely more upon the judgement of an Artiſt, than upon his owne, and ſpecially when it is bent upon the ſafeſt and the moſt charitable courſe. And this counſell I give them, to fortifie only the ſaid End, according to the modell inſerted in the

the 23 Plate; now they may conveniently do it, will be worthy of thanks if they embrace it; but if they do not, if ever they be beſieged, it will produce an after-wiſh, as thoſe of Leiceſter did, when it was too late; O that wee had followed ſuch an advice and counſell: And ſo much for the diſcharge of a good conſcience.

5. And laſtly, it was invented to fortifie ſome places of refuge in the time of a Civill War, that a whole Countie be not ruinated by a roving and plundering Army: But in this, the Committees of ſuch Counties are to be verie cautious in their election of a ſeat, for all the head-Towns of Counties are not convenient to erect Garriſons: And therefore I ſhall acquaint them in the next Chapter, of the beſt and of the worſt ſeats for a Garriſon: And will only for a concluſion of this point, informe them, that all ſeats of Garriſons, if they may be found, are to be as neare the middle of the Countie as may be, that they may the ſooner releeve all the parts of the Countie: And that by no means they aſſent to erect any more than one in one and the ſame Countie, that they may be the better able to fortifie, man, and provide the ſame to ſome purpoſe; for pluralitie of Garriſons in one and the ſame Countie, whether they are foes or friends, are deſtructive to a Countie.

Chap. V.

Of the beſt, and of the worſt Seats for Garriſons.

And firſt of the beſt Seats, as better deſerving the preccedency; a good Seat is to be freed of all ſides, from hills or raiſing grounds that may command, or of all hollowes that may indanger the Garriſon it ſelfe, or the Workes of it; If the Towne hath walls,* a good Enginier is not to regard them, ſpecially if there be hollowes, and raiſing grounds within Cannon-ſhot of them; for it it is not the lining of theſe walls, or the erecting of Mounts near or upon them, or the drawing of ill-lined and ill-flanked dikes within five or ſix yards of them that will ſecure

* Mr. *Ward* is alſo of the ſame opinion concerning our old walls. See pag. 35. and chap. 20.

cure the ſame. But a prudent Enginier is to let them ſtand, as a ſecond weake defence, to obtaine a parley after all is loſt, and yet not to rely on them, for they are rather deſtructive helps then profitable defences; But to draw his Line of Communication one hundred yardes or more into the field bevond them, to take in thoſe hollowes that will indanger, and hills or raiſing grounds that will command his Workes. Or if they be too farre diſtant from the walls, he is of neceſſity to erect well flanked Forts, or Redoubts to ſecure them, or all his Workes will not be worth a button; let his Workes be never ſo well carried up, or lined out. And theſe Forts are to have Corridors, or covered wayes to retreat into, for to be relieved from the main Line of Communication, out of danger of the aſſailants ſhot: for a raiſing ground left out of the Line of Communication of Leiceſter, was the ſecondarie cauſe of the loſſe of it, and of a hundred townes more, if an abſtract did permit to produce divers like inſtances. And as for Mounts erected neare or upon old walls, they are of no other ſervice, then to hinder the aſſailants approaches, for a day or two; but when their approaches are made, they are of no defence at all, for having a raiſing ground within Cannon-ſhot, one may diſmount all the Ordnance upon them in an inſtant of time; and for the musket-ſhot, they are alſo of no uſe, becauſe the ſhot of the Musket doth not fly upon a levell line, but upon a deſcending line from a great height downwards, and ſo can hurt none except it be at point-blanke, but upon a levell line, if the bullet miſſe one, it will hit another, and what is ſaid here of the musket-ſhot, it may be applyed to the Cannon-ſhot, for if the aſſaylants had no raiſing ground to diſmount the Cannons placed upon theſe Mounts, their Cannon-ſhot cannot offend them, when their approaches are within one hundred yards of theſe Mounts, for it is the long diſtance that giveth a levell line to the Cannon-ſhot, when it is mounted ſo high. And as for the lining of old walls and the making of dikes ſo neare them, they are diſtructive wayes for the defendents: For the firſt, the earth and walls doth never bind together, but falls and helpes to fill and levell the town dike upon the firſt ſtorme of the Cannon-ſhot that is ſhot againſt the walls. And as for the ſecond, the very ſplinters of the wall during a Cannon ſtorme will drive the defen-

defendents from the Breſt-Workes of theſe dikes, that are ſo near the Walls, to a ſhamefull deſertion of them, to ſave their lives, and ſo they will become by accident a verie ſafe intrenchment for the aſſayllants, and ſo much be it ſpoken upon this ſubject for them, to whom it concerneth.

Of the beſt Seats.

1. The beſt ſeat of all ſeats, is a Haven towne freed on the land ſide of the fore-ſaid impediments, having a ſafe rode for ſhips, and a deep and broad channell for the coming in, and ſuch a one was Tyrus and Rochell, for a Garriſon ſo ſeated can hardly be reduced without a Sea Navy and a Land Army, and how inconſtant the winds and ſeas are when winter is at hand, all ingenious men know. Therefore it is to bee reduced in a ſummer, or divers accidents may fall out, to free the ſame from the reſtraint by ſea, and as for Tyrus * after three yeares ſiege, and an incredible charge, to make a mole over a bay of the ſea, to reduce the ſame, the great Army of *Alexander* found in it but a ſmall recompence for their labours, for the richeſt Inhabitants ſaved themſelves and their treaſures by ſea: and as for Rochell, if the Cardinall *de Richelieu*, or his Enginiers for him, had not found an admirable invention to make a floting bridge with great Liters over a narrow arme of the ſea, fortified on both ſides the Land with two ſtrong Forts, having in the midſt two great Platformes erected, every of them upon foure great Liters faſt chained one to another with ſtrong iron chaines, Rochell * might (according to humane reaſon) have been at liberty at thi day.

* See Sir *Walter Rauleigh* his Hiſtorie of the vvorld.

* See the French Hiſtorie.

2. The ſecond is a Towne ſeated upon a raiſing hill in the midſt of a Champion Countrey, well provided with ſprings and ciſternes of water, having an even flat top, and all the ſides but one, of ſtraight down and Rockey cliffs of foure thouſand yards Diameter, and ſuch a one was Beeſton-caſtle in Cheſhire, for ſuch a place cannot be reduced but by famine.

3. The third is a Towne ſeated in a Champion Countrey, free of the aforeſaid impediments having an unfordable river running in the midſt or cloſe to one ſide of it, and ſuch another is Newarke, for it cannot be reduced without an intrenched Camp (if the Workes be high and ſtrong) and two bridges traverſing the river, that the one Army of one ſide may relieve the other on the other ſide, as occaſion requireth.

4. The

4. The fourth is a Towne ſeated on the ſide of a hill having a deep river running in the foot of it; whoſe buildings and works extend themſelves to the verie top of the hill, and her Fortifications unto the two ſides of the river, and ſuch a one is Nottingham, had it not as it hath a ſandy ſoile, yet this defect may be remedied with art and charges.

5. The fifth is a towne ſeated upon a raiſing ground, in the midſt of a mariſh, having but one coming to it, provided with wholſome ſprings, and ſuch a one is Peſſaro in Italy.

6. The ſixth is a dry towne ſeated in a Champion Countrey that is of a good ſoile, and in a place where divers Roads meet, and upon the borders of three or foure Counties, for this being regularly fortified, is of great defence, and of great advantage to the owners of it, and ſuch a one is Cremona in Lombardia.

Of the vvorſt Seats.

The worſt ſeats are theſe: Firſt, a Towne ſeated betweene two hills, within Cannon ſhot; Secondly, a Towne ſeated in the midſt of a Mariſh, upon a flat and even ground: Thirdly, a Towne ſeated upon the ſide of a hill, the top of the hill commanding the ſame: Fourthly, a Towne ſeated upon a hill barren of water, and a rockey ground; Fifthly, a Town ſeated upon a ſandy ſoile. Sixtly, a Towne ſeated in the midſt, or on the ſide of a Forreſt.

Chap. VI.

Of the forraigne Fortifications and Dimenſions.

THe greater part of the forraigne Fortifications are not for our imitation, becauſe they require a long time to erect them, and more men then we have, or are able to pay, to maintaine and defend them, and more means to finiſh them, then we have at this preſent, the meanes of this Nation having beene exhauſted, by this unnaturall warre: Therefore I will omit to ſpeak of their Cavalliers, Faulſes, Brayes, Tenailles, Horneworks and Out-works of their Ravellins, and Corridors, or covered wayes, as being altogether unuſefull for us, for the reaſons above

above expreſſed. Yet to ſatisfie the curioſity of the reader, I will treat of two of their methods of Fortifications, by Baſtions without, and with Orillons, and of the dimenſions & proportions they obſerve in them, that the Reader may the better judge, whether theſe chargeable works are convenient for us, or no. I will alſo ſpeak of another of their Methods of Fortification by Avant Guards, newly invented by *Honnorat de Meynier*, a rare French Enginier, that would be as chargeable as any of the other two, if we did not reduce it to ſhorter dimenſions, and wholly omit the coſtly Free-ſtone Works they adorne them withall. And I do it the rather, becauſe this kind of method (above all others) is more capable of diminution in her proportion, and be little or nothing at all the worſe.

But I will (in the firſt place) repreſent unto you the proportions and dimenſions of the two methods by Baſtions without, and with Orillons, that have no difference at all in their proportions and dimenſions, but only in the Line of the Flanks, and in the turning and framing of the Orillons.

Firſt, the dikes of theſe two Methods are ordinarily between foureſcore or fiveſcore foot broad, and their depth about twentie five, or thirtie foot deep.

Secondly, they have another ſmaller dike in the middeſt of theſe great dikes, if in caſe they be drie, called *La Cunette*, that is ſome foure and twentie foot broad, and twelve or ſixteen foot deep; this ſmall dike is commonly full of water in all places; for the raine-water deſcending from the Rampiers, and the ſides of the great dike, fill it, although the ground be voyd of ſprings; this ſmall dike is verie uſefull, for it preſerves the Garriſon from being ſcaled, or ſurprized in the night time, for the undertakers cannot paſſe the ſame without they caſt a caſting-bridge over it, and that cannot be done without noyſe, and this noyſe waketh the Sentinells, and alarmes the Garriſon; and with the earth of this dike they commonly make their Counterſcarp breſt-work, adorning the ſame within ſide with turfe, and one foot ſlope, the reſt being laid or ſpread aſlope, till it come to nothing, and even with the firme ground; that the French call *Glacis*.

Thirdly, their Rampiers are commonly foureſcore or fiveſcore foot broad in the bottome, with a ſlope on both ſides of two foot

or

or a yard high; but on the wall ſide it cometh no lower than the boltill of the ſtone walls, that the French call *Cordeau:* for upon that boltill they ſet their battlements of their wall, that are about five or ſix foot high, having a Port-hole at every two yards, and three foot from the *Cordeau*, and by reaſon of the great ſlope, that the Rampier hath, a way of ſome eight foot broad is preſently formed, that runneth between the battlements of the wall, and the Rampier, that is called the way of the rounds, and in French *Le chemin des rondes*, and this way goeth from one Baſtion to another, round about the Garriſon; a very commodious and neceſſary meanes for the Rounds to go ſafe in the night, and to diſcover by looking out of the Port holes of the battlements, if any appeares neare to their Counterſcarp or Corridor that are on the other ſide of their dike, and the Rampier beſides the Breſt-work upon it, is commonly ſix foot higher then the battlements of the walls, and the Breſt-worke ſix foot more; ſo that the ſplinters of the wall during a battery, cannot offend the ſouldiers, that defend the Breſt-workes of the Rampier.

Fourthly, the Rampiers are commonly thirty foot high, beſides the height of the Breſt-worke that is ſix foot high within ſide, for it hath a foot-ſtep of eighteen inches high, and two foot broad, and the whole height of the Rampier with his Breſt-worke, is within ſide thirty ſix foot, and without thirty three foot high, becauſe the top of the Breſt-work is carried three foot ſlope, becauſe it is alwayes twenty foot broad at top to be of Cannon-proof: and the Rampier beſides the thickneſſe of the Breſt-worke and the ſlope of the two ſides defalked, is alwayes forty foot broad on both ſides, on which they plant Elmes or Sicamore Trees, that in few yeares make very pleaſant and ſhadie walkes, that ſerve in time of ſiege for a way for horſe, men, foot and carriages, to come to defend and relieve the Rampier.

Fiftly the diſtance from the Center of one Baſtion to another is commonly from two hundred fifty yards to three hundred yards.

Sixtly the faces of their Baſtions are ordinarily from one hundred yards to one hundred twenty yards, beſides the turning of their Orillons that is about twenty yards.

Seventhly the whole gorge of their Baſtions are from one hundred

hundred yards, to an hundred and twenty yards, from out to out.

8 The breſt of their Baſtions are from 120. yards, to 130. yards.

9 And from the center of the Baſtion, to the point, or the utmoſt Angle of the Baſtion, from 80 yards to 100 yards.

10 The flanks of the Baſtions from 42 yards to 50 yards, that is divided into three equall parts, if they make Orillons; one part is allowed for the flank, and the other two for the turning and the framing of the Orillons.

11 Their curtaines are alwayes betweene 160 yards to 200 yards.

12 The Line of Defence, to be good for the defence of the musket ſhot, is to be from 220 yards, to 250 yards, at the moſt.

13 The ſlope of their Breſt-works without ſide, is one foot for every yard, if the earth be good; and within ſide a foot in two yards: but if it be a ſandy ground, or a running clay, it requires a foot and halfe without ſide, and a foot within, for a yard high.

Novv let the Reader judge, vvhether theſe coſtly Fortifications be for our turn.

14 The foundation of theſe walls begin from the bottome of the dike, and are carried up to the upper water-table of the wall to the *Cordeau*; and from the bottome of the dike on the field-ſide levell with the ground, and all of free ſtone. The middeſt of the Baſtions are filled up with earth to the *Cordeau*, and made ſlope to the firme ground of the towne, and their Rampiers and Breſt-works are raiſed fifteen yards above the *Cordeau*.

Chap. VII.

Of the ſuperficies contained in the firſt Plate.

SInce the Principles of Geometry are the very ground-work of the Art of Fortification, I judge it convenient to begin this Abſtract, by the demonſtrations of ſuch ſuperficies as are moſt commonly uſed in the practice of this Art.

A Superficie is properly any kinde of forme demonſtrated upon Of Superficies

upon paper, or upon the ground, incloſed with three lines at the leaſt, except it be the circulary forme, that hath but one circulary line, that begins at one point, and ends at the ſame.

Of the Point. The point is a ſmall touch of the pen, that cannot be divided, becauſe it hath no parts, but is the beginning and end of all lines, and the center of all Formes. See Figure 1.

Of Lines. A line is the continuance of a point that is incapable of diviſion; but in the length of it, it is diſtinguiſhed by divers termes: As, by the ſtrait line, in Figure 2. by the circulary line, in Figure 3. by the perpendiculary line, in Figure 7. by the parallell line, in Figure 8. by the diagonall line, in Figure 11. and by the diametricall line, in Figure 12. There are divers other diſtinctions of lines, but they are not uſefull in this Art.

Of Angles. All Angles derive from the conjunction of two lines in one point; whether they be ſtrait, circulary, diagonall, or mixt with any one of theſe. As Figure 4. is called a plaine Angle, becauſe two ſtrait levell lines, from one and the ſame diſtance, meet at one point, and a ſtrait perpendicular, and a levell line falling in the midſt of a ſtrait line, produceth an Obtus, and a ſtrait Angle, as in Figure 7. And two circulary lines meeting at one point, maketh a circulary Angle, as in Figure 5. And a ſtrait and a circulary line meeting at one point, produceth a mixt Angle, as in Figure 6. There are alſo divers other ſorts of Angles, ſome of which we ſhall have occaſion to ſpeak of in another place.

Of the eighth Figure. The eighth Figure demonſtrates how to make a perpendiculrie line cut a ſtrait line given, and how you may cut that perpendiculary line in three parts, by three demicircles, to make up the line given, three parallell lines, without altering the compaſſe to any other diſtance but the firſt.

Firſt, let a ſtrait line be given, then take the juſt diſtance of that line with your compaſſe, and ſet one of the points of it upon the right hand end of the line, and with the other point make a ſmall demicircle above; then remove the point of your compaſſe upon the left hand ſide of the line given, and with the other point make another ſmall circle, cutting the firſt; and where theſe two ſmall circles cut one another, ſet your rule, and draw a ſtrait line to the line given, and it will cut the ſame with a ſtrait perpendicularie line. Now to avoid all errour that might proceed from

from the miſ-placing of your Rule upon the line given, make but two other ſmall demicircles below the line, as you did above, and where theſe cut one another, put one end of your Rule, and the other, upon the upper cutting of the two ſmall demicircles, and draw a ſtrait line, and (of neceſſity) the perpendicularie line will be ſtrait, and without errour.

Now to cut that perpendicular Line in two equall parts more, to make up the Line given, three parallel Lines, ſet your compaſſe upon the juſt diſtance of the length of the perpendicularie Line, then ſet one of the points of the Compaſſe, upon the lower end of the perpendicularie Line, and make a demy circle upwards, then remove your Compaſſe upon the upper end of the perpendicularie Line, and make a demy-circle downwards, then remove the point of your Compaſſe upon the Center-point, where the perpendicularie Line did cut at the firſt the Line given, and make the third demy-circle upwards, and this demy-circle will cut the other two in foure places, and where they cut, ſet your rule, and draw two ſtrait Lines, and theſe will make up the Line given, three perfect parallel Lines, as it is clearly demonſtrated in figure 8.

Of the ninth Figure.

The ninth figure ſheweth how to draw as many parallel Lines as you pleaſe, upon two lines, that are the upper and the lower lines in this figure. Firſt, let two equall lines be given, one below, & another above, according to the length you deſire to have your parallel lines, then divide theſe two lines with your Compaſſe, in as many parts as you deſire to have parallel lines, and at everie diviſion make a point, and from everie point make a demy-circle above the upper and the lower given lines, then ſet your Rule upon them one after another, and draw as many lines as there is demy-circles, and theſe will all be perfect parallel lines. Now if you will double theſe parallel lines, it is but to divide with your Compaſſe the juſt bredth of them in two parts, and at everie diviſion to make a point, and to ſet your Compaſſe againe upon its firſt diſtance, and to cut your firſt demy-circle with it, and to draw as many lines, and you ſhall have as many more perfect parallel lines as you had before, as it is clearly demonſtrated in Figure 9.

Of the tenth Figure.

The tenth Figure ſheweth how to make a ſquare and a trian-

gle upon a line given: Suppoſe the Baſe of the ſquare is the line given, now to make a perfect ſquare, and foure Scalene triangles of this line, you are to ſet your Compaſſe upon the juſt diſtance of the line, and to ſet one point of it on the right hand end of it, and to make a demy-circle, and to remove your compaſſe upon the left end, and to make another demy-circle, and where they cut one another, ſet your rule, and draw a perpendicularie line, then turne your rule, and draw a ſtrait top line, and joyne the baſe line with this top line, by two ſtrait lines, and you will have a perfect ſquare, and foure perfect ſquare ſcalene triangles, as it is demonſtrated in Figure 10.

Of the eleventh Figure.

The eleventh Figure ſheweth how to make a paralograme out of two circles. Firſt, ſet your compaſſe upon the demy bredth of the paralograme, that you intend to make, and then make a circle on the right hand, then remove your Compaſſe-point upon the extreame of the firſt circle on the left hand upon a ſtrait line, and with the other point mark the Center-point of the other circle, then turne your compaſſe round, and you will have two circles, whoſe extreams will touch one another, then ſet your rule upon the foure extreames of theſe two circles, and draw foure ſtrait lines; and where theſe lines cut one another, there is the foure Angles of the Paralograme, as it is demonſtrated in Figure 11.

Of the twelfth Figure.

The twelfth Figure ſheweth how to make a perfect ſquare by the out-ſide of a circle: Make choyſe of your Center, and ſet your compaſſe upon the verie Diameter that you intend to have your ſquare, then make a circle, and draw foure ſtrait lines upon the extreames of it, and it will produce a perfect ſquare, as is demonſtrated in Figure 12.

CHAP.

Chap. VIII.

Of the Superficies contained in the ſecond Plate.

AMong all other Superficies there is none ſo uſefull for the Art of Fortification, as the Triangles; and yet Mr. *Ward* in his *Animadverſions of War*, makes mention but of three ſorts, yet there are ſix principall ſorts of Triangles, from which all other mixt Triangles are derived; and theſe ſix ſorts may be all ſet out by the Circle, as it is demonſtrated in this Plate.

1 Of the equilaterall Triangle, and the beſt vvay to ſet out the ſame.

The equilaterall Triangle deſerves the precedencie, becauſe it is the only Triangle that can be fortified by Baſtions, for all her ſides are equall; the beſt way to ſet it out, is to ſet your Compaſſe upon the juſt diſtance of the Baſe of it, and to make two points with your Compaſſe, and to draw two Demy-circles, one from the right point, and the other from the left hand point, and where theſe Circles cut one another, make the third point, and draw three ſtrait lines to theſe three points, and it will produce a perfect equilaterall Triangle equall of all ſides.

Hovv to ſet out the equilaterall Triangle by a Circle.

Some ſet it out by the Circle, dividing the Diameter of it in foure equall parts, and draw a ſtrait line upon the firſt quarter point, as the Baſe of it, and two lines more from the two ends of the Baſe to the top of the Diametricall Line of the Circle; but this way is not ſo perfect as the other. See Figure 13.

2 Of the ſetting out of the Iſocele Triangle.

The Iſocele Triangle is alſo verie uſefull in the Art of Fortification; for all the regularie Poligons of many Angles, after the Sexagon, are compoſed of Iſocele Triangles; but the Sexagon is compoſed of ſix equilaterall Triangles, that have all their ſides equall: But the Iſocele Triangle hath alwayes two ſides equall, and longer than her Baſe; it is ſet out after this manner out of the Circle. After your Circle is made draw a ſtrait perpendicularie Line Diametricall wiſe upon the Center of it to the two extreames of the Circle, then divide that laſt Line into eight equall parts, and draw a ſtrait line with your rule, upon the firſt point of the eighth part diviſion, from one extreame of the Circle to another, and that Line repreſents the Baſe, then draw two ſtrait lines from the two ends of that Baſe, to the top-point of the Diametricall

Diametricall Line of the Circle, and theſe three Lines will produce a perfect Iſocele Triangle. See Figur 14.

3 Of the rectiligne Triangle, and hovv it is to be ſet out by the Circle.

The Rectcligne Triangle is alſo uſefull in the Art of Fortification to ſet out Halfe Moones, her Baſe contrarie to the Iſocele Triangle is longer then her two ſides; it is ſet out after this manner: After your Circle is made, draw a ſtrait Line from the two ſide extreamities of the Circle, and cut with that Line the Center-point of the Circle, and this Line repreſents the Baſe, then draw two other Lines from the two ends of the Baſe, to the upper point of the Circle, and two other Lines from the two ends of the Baſe, to the lower point of the Circle, and it will produce two perfect Rectcligne Triangles, that makes alſo a perfect ſquare Rhomb.

4 Of the ſcalene Triangle, and hovv it may be ſet out by the Circle.

The Scalene Triangle hath all her ſides unequall, it is very uſefull for meaſuring of land; for two of them make an Equilaterall Triangle, and foure of them a perfect long Rhomb. It is to be ſet out after this manner. After your circle is made, divide the ſide diametricall line of the circle into eight equall parts, then cut with a ſtrait line the firſt eighth point of that diviſion on the left hand point, and then divide the diametricall line of the circle that is drawne perpendiculary-wiſe into foure equall parts, and cut with another ſtrait line the firſt equall point of that diviſion towards the Baſe, or the lower ſide of the circle; then from the two ſides of theſe two lines draw a ſtrait diagonall line, and theſe three lines will produce a perfect ſcalene Triangle. See Figure 21.

5 Of the Oxigon Triangle, and hovv it may be ſet out by the Circle.

The acute Angle, or Oxigon Triangle, is onely uſefull, for meaſuring of land, all her ſides are alſo unequall, and all her Angles acute, you are to ſet it out after this manner: After the Circle is made, draw a Diametricall line perpendiculary-wiſe, that may cut the point of the Center from the top of the Circle to the bottome; then from the lower end of this line on the left hand, make a point at the fourth part of the Circumference of the Circle, and another point on the right hand, at the third part of the Circumference of the Circle; then draw a line from the left hand point to the right point, and two other lines from the right hand, and the left hand point, to the top point of the Diametricall line, and theſe three lines will produce a perfect Oxigon Triangle; ſee Figure 22.

The

The Obtus Triangle is uſefull in Fortification, and for meaſuring of Land, two of her ſides are equall, and containe but the two third parts of her baſe, her baſe being longer then her ſides by a third part, it is to be ſet out after this manner: After the circle is made, divide the Diametricall line of it into three equall parts, and cut the firſt point of this diviſion by a ſtrait line, and this line repreſents the baſe, then draw two lines from the two ends of this baſe, to the top of the Diametricall lines, and theſe three lines will produce a perfect Obtus Triangle, ſee Figure 23.

6 Of the Obtus Triangle, and how it may be ſet out by the Circle.

Now I come to the 24. Superficie that containeth an Ovall, and in that Ovall two long Rhombs, a Paralograme, two equilaterall Triangles, and foure Scalene Triangles. But becauſe I have already ſpoken of all theſe, the Ovall and the two long Rhombs excepted, I will begin with the Ovall, the moſt difficult of all other ſuperficies to be rightly ſet out upon paper, or in the field.

Of the ſetting out of the Ovall.

To ſet it out upon paper, you are to ſet your compaſſe upon the ſcale of the third part of the length you intend to have the Ovall, and this third part is to be divided againe into two equall parts, and your compaſſe ſet upon that ſixth part: then make choice of your Center, and cut the point of the Center with two ſtrait lines, one of them perpendiculary-wiſe, and the other diametricall-wiſe: then ſet one of the points of your compaſſe upon the Center point, and with the other make a point upon the diametricall line on the right hand, and another point upon the ſame line on the left hand, then ſet the compaſſe againe upon the third part of the length of the Ovall, and ſet one of the points of it upon the right hand point, that repreſents the End of the third part of the line of the length of the Ovall, and with the other point of the compaſſe make a circle, then remove the point of the compaſſe, and ſet it upon the left hand point of the aforeſaid line, and make another circle and the two extreams of theſe two circles repreſent the length of the Ovall. Then remove your compaſſe and ſet one point of it upon the lower cutting of theſe two circles, and ſet it at that diſtance, that having a point upon this lower cutting of theſe two circles, it may conjoyne with a true

circularie

circularie line, the two upper extreames of the two circles, that being done, remove your compasse, without any alteration of the distance, and set one of the points of it, upon the upper cutting of the two circles, and with the other point of it, make a true circulary line, to joyne the two lower extreames of the two circles; and this being traced with a pen, will produce a perfect Ovall, one third part longer then it is broad; some make it halfe as long againe, as it is broad, but the sides are too flat, and the Ovall is by it more deformed, and not so seemly and compleat as this is, demonstrated in Figure 16.

Of the setting out of the Rhomb.

Now to make the most perfect Rhomb that can be made, you are but to draw foure lines dioganall wise, from the upper and lower points of the perpendicularie diametricall line, that cuts the two broad sides of the Ovall, to the two points of the diametricall line of the length of the Ovall, and it will produce a perfect Rhomb, as in figure 18.

Of the setting out of the 6. Triangles.

And to make the two equilaterall Triangles, and the foure scalene Triangles out of the smaller Rhomb, you are but to draw four lines diagonall-wise from the two Ends of the first line that did represent the eighth part of the Ovall to the two upper and lower cuttings of the two circles, and these lines (with the two diametricall lines of the length and breadth of the Ovall already drawne) will produce these six fore-said Triangles.

Of the setting out of the Paralograme.

And to set out the Paralograme, you are to divide the breadth of the Ovall into four equall parts, and the length of it into nine equall parts, and at every division to make a point, and to draw foure strait lines upon the first points of these two divisions, and they will produce this Paralograme that is a ninth part longer then twice his breadth.

CHAP.

CHAP. IX.

Of the Superficies contained in the 3. Plate.

THe firſt Circle of this Plate contains an Equilaterall Triangle, a Square, and a Pentagon. And becauſe all the Equilateral Triangles that are ſet out by a Square have their two ſides longer then their ſquare by an $\frac{1}{8}$ part; I have drawne two demy-circles to ſhew where the upper Angle of the Triangle ſhould come to be perfect and equall of all her ſides, and that is where the two circles cut one another. As for the ſquare, it is more eaſie to ſet it out from without the circle, then from within the circle, becauſe it is more difficult to reduce the ſides of it to that ſcantling propoſed, if in caſe you ſet it out by the inward ſide of the circle, then it is if you ſet out by the out-ſide of the circle; for the diametre of the circle is of the juſt length of the ſides; but to take out a ſquare out of the inward ſide of the circle, the demy-diametricall line of the circle is to be one third part longer then when you make it by the out-ſide of the circle. But if you are not tyed to a ſcantling, then you may make as perfect a ſquare our of the inward ſide, as well as from the out-ſide of a circle, by dividing the two croſſe diametricall lines of the circle, into 6. equal parts, and by drawing 4. ſtraight lines, cutting the foure firſt points of this diviſion in the foure ſides of the circle, drawing the lines to the inward extremes of the circle, and theſe lines wil produce a perfect ſquare.

Of the ſetting out of the equilateral triangle out of a ſquare.

Of the ſetting out of the ſquare by the inward ſide of the circle.

Concerning the ſetting out of the Pentagon, you are to divide the circumference of the circle into five equall parts, and at every diviſion to make a point, then you are to draw five ſtraight lines from point to point, and theſe five lines repreſent the five ſides or baſes of the Pentagon: then you are to draw five other lines from the center point to the end of theſe five baſes diagonal wiſe, and theſe five lines compleat the five ſides of the five triangles of the Pentagon; and this being done, this ſuperficie is perfected.

The other three Circles contained in this place are to ſet out

in every one of them a Poligon with different Angles: *viz.* The first a Sexagon, the second a Septagon, and the third an Octogon; having all of them the Basis of their Triangles of an equall length, by the encreasing the circumference of the circle of the length of one of the Bases. And because this is a point of great concernment to an Enginier, that may by the same know at an instant how many Bastions the place will require, if he doth but know the true circumference of it, I will expresse my selfe more clearly.

Suppose then that the six Bases of the six equilaterall Triangles of a Sexagon contain 250. yards a piece, that is in all 1500. yards circumference. And that you would set out a Septagon with seven Bases that should contain every one of them 250. yards a piece, you are then to adde to the demy-diametricall line of the Sexagon, a sixt part more of the extent that it had before; and by this meanes the circumference of the circle will be able to afford you seven Bases of 250. yards a piece, that is in all 1750. yards. The reason of it is, that the circumference of a circle containes three diametricall lines, so that you are of necessity to adde to the former demy-diametre line of the Sexagon, a sixt part more then it had before, because a demy-diametre is but the sixt part of the circumference of a circle.

And by this rule you may make all the Bases of any Poligon from six Angles to twenty foure Angles, nay to eight and forty Angles if you please, of two hundred and fifty yards a piece, adding alwayes to the demy-diametre as followeth; To make a Septagon you are to adde the $\frac{1}{6}$ part; to make an Octogon you are to adde a seventh part; to make a ninth Angle Poligon you are to adde the eighth part; and so as you goe on, the ninth, the tenth, the eleventh, or twelfth part. And as I have said, you are to observe that course, till you come to set out a Poligon of eight and forty Angles. That I conceive would be sufficient to fortifie the City of London on both sides the water, with as large a Line of Communication as it hath at this present, having at every two hundred and fifty yards distance an Angle, to forme a strong, complete, and defensible Bastion. A farre

more

more beſeeming a Fortification for ſo famous a City, then ſuch ſleight, winding Angles, and ill flanked Redouts, wherewith it is now fortified.

CHAP. X.

Of the five Redouts contained in Plate 4.

BEfore I come to ſpeake of the Superficies of theſe five Redoubts, it will not be amiſſe to inform the Reader of their extent, continent, and dimenſions. And firſt of their extent. All ſquare or circullary redouts are to bee of one hundred yards from out to out in their diametricall line, otherwiſe their inward continent will be too ſmall. But a Triangle redout is to have her three ſides of two hundred yards a piece, becauſe two equilaterall Triangles containe no more then a ſquare. Of the extent of Redouts.

Secondly, their continent is to be ſo large, as it may lodge a competent number of Souldiers for their defence, that is, two hundred men at leaſt, and every two men cannot have a ſmaller piece of ground allowed them for their lodging then a piece of eight yards ſquare, that makes in all ſixty four ſquare yards; Now a redout of one hundred yards diametre, reduced in the forme of a ſquare, will contain but 10000. ſquare yards; out of which you are to defalke a third part, for the Rampiers, the place, and the ſtreets; and then there will remaine but 6667. yards for the lodgings; and this being divided by ſixty four yards, it will containe but two hundred and eight Soldiers lodgings, if two of them be lodged together in a chamber of 24. foot ſquare. And by this you may judge whether the greater part of the Redouts about the City of London are of a proportionable extent, ſeeing moſt of them have not fifty yards of diametre. Of the conti-nent of redouts

Thirdly, for their dimenſions. Their ditches are to be tenne yards broad, and five yards deep, and the ſlope of the ſides of theſe ditches are to be but one foot ſlope in three, that the bottome of the ditch may remain to be twenty foot broad, when Of the bredth and depth of their ditches.

it is fifteen foot deep, for the reasons that will be shewn when I come to speak of the contre escarpe: and the Rampiars their Breast-works are to be proportionable to this ditch. The height of it within side is to be twelve foot high, and nine foot without; the slope of it within side is to be but one foot in six, and one foot in three without side; there are to be five foot-steps of two foot broad a piece, and of eighteene inches high a piece, that the breastwork may not be above foure foot and an halfe high, that is of a convenient height for tall and middle siz'd Soldiers to discharge easily their Muskets. The top of the breast-work is to be twenty foot broad, to be of Cannon proofe, and is to have a slope of three foot, and that is the reason that the out-side of the Rampiar is to be but nine foot high, and within side twelve foot high, for by this slope the Musquetiers can defend the very brim of their ditch, which otherwise they could not doe. Moreover, this great slope preserves the Works from cleaving in the midst, because all the raine water falls off from them into the ditch. And by these dimensions your Rampier with the five foot-steps will be foure and thirty foot in the bottome, and twenty foot at top: a very sufficient Rampier to oppose a good battery.

Of the height and thicknesse of their Rampiers.

Of their slope within and without.

Of their five foo.-steps.

Why the slope of their top is to be a yard.

These broad and high breast-works require to be brought up with brush or bavin wood, if you desire they should be of continuance; the smallest bavin wood is the best, and it is to be bound up with bands, and of some foure foot long, and some foure or five inches thick; the smallest end of the bavin is to lap over the turfe on both sides, and the thickest end is to be turned toward the middle of the Rampier; and when you have laid foure rows of them, every end lopping one over another halfe a foot, you are to cast in the midst of the work, a row of such bavins of six foot long, to serve as a key to binde all the rest; and this course you are to observe so soone as your turfe is risen to be eighteene inches high; so that in the height of a yard, there are to be two such courses of bavins, that is in all six courses of bavins for a Rampier of nine foot high without side, and of twelve foot within side; for the last course of bavins is to be placed when your out-side is eight foot high, that there may be eight inches high of earth to cover the bavin wood. And after

How the Rampiers are to be lined with bavins.

after every course of these bavins, before you place another course, halfe a dozen of the strongest Pioniers are to ramme the earth stoutly, with rammers made of a three inch'd plank, of a foot square, with a strong stake fastned to it. If this be but observed, you will have strong and permanent works; but those that will not goe to these charges, are to expect to have the greater part of their works to be repaired every spring, and these repaires will be as tedious, and almost as chargeable as to make new ones.

Now when these ditches are finished, and the Rampiers and their five foot steps perfected, and hay-seed sown on the top of the breast-work, after it hath been raked and rammed, you are to erect your Contre escarpe after this manner: Your great ditch being twenty foot broad in the bottome, if in case it be dry, or if it hath but a little water, you are to cast it out, and to make in the midst of it another ditch, that the French call *La cunnette* of sixteene foot broad and nine foot deep, leaving a foot-step of two foot broad on both sides; and these foot-steps preserve your great ditch from calving in, and serve in Forts for the footing of casting bridges, to sally in the night upon the assailants out of salley-ports made on purpose under the orillons of the bastions; and this manner of double ditch all in one, is farre safer then these small double ditches, having a bank of earth of some two foot broad left between them, used and erected about the London Redouts. Of the *cunnette* or small ditch.

Now all the earth that is digged out of this small ditch, is to be cast on the field side; and as it is cast out, other Pioniers are to stand upon the brim of the great ditch, for to cast the said earth twelve or fourteene foot farther off into the field; and when this is done, and the smaller ditch perfected, then you are to make the breast-work of the Contre escarpe with this earth, adorning the inside of it with turfe, and with a foot-step of two foot broad and eighteene inches high, and the breast-work higher then that foot-step by foure foot and an halfe. And having levelled even and rammed the top of the breast-work some two foot broad, you are to lay all the rest of the earth so slope till it come to nothing, and levell with the firm ground; and this slope is called for distinction sake, by the French, How a contre escarpe is to be made. Of the slope of the breast-work of the contre escarpe, that the French call *Glacis*.

French, *Glacis*. And by this meanes a ſufficient and defenſible Contie eſcarpe will be made round about the Works of the Redouts twelve foot diſtance in every place from the brim of the great ditch.

I have been the larger in the deſcription of theſe dimenſions, becauſe I intend that theſe very ſame directions, ſhall ſuffice once for all, for the two laſt methods ſpoken of in this abſtract; which in all parts are to be like theſe, if the erectors intend to have ſtrong and permanent works. Maſter *Ward* in his Animadverſions of Warre, would have the ditches of a Redout to be but nine foot broad, and ſix foot deep, and the breſt-work ſix foot high and ſix foot thick; but theſe dimenſions are contrary to the Rules of Art, for theſe reaſons:

1. The top of the rigge of the lodgings of the Souldiers is to be covered by the height of the Rampier, which cannot be done if they be ſo low.

2. When a ditch and rampier require a ladder of 30. rounds to ſcale the ſame, it is more dangerous and difficult to ſcale and to ſtorm then when it requires but a ladder of 12. rounds.

3. When the ditches are ſo ſhallow and ſo narrow, they are preſently levelled with bavins, and one ſoldier helping another with a Pike, may eaſily get up on the Rampier, and the other with his Pike drive the defendants from the defence of the Rampiers. In a word, it were better to erect no redouts at all, then to erect any ſo ſleight, and to expoſe mens lives to danger after that manner, for ſuch a redout will be gained at an inſtant by a Storme. Moreover, there is to be a good Well, and two Ciſterns made of Free-ſtone, plaſtered with Tarris, to receive all the raine water that falls upon the tiles of the ſoldiers lodgings, that are to be built by long ranges, and not to exceed in height 12. foot when the rigge tiles are up, to be free from the enemies battery; and every roome of 24. foot broad, may be divided in two of 12. foot broad, and 24. foot long; in the one may be the two ſoldiers beds, their apparell and Armes; and in the other, their drink, victuals, fuell, and all other neceſſaries. And theſe ranges are to be lined out according to the forme of the ſuperficies of the redout; if it be a Triangle, Triangle-wiſe; if it be a ſquare, after a ſquare manner; if it be of a fift, ſixt, ſeventh,

venth, or eighth angle form, the ranges are to be after that manner, that a place be left in the midſt of the redout juſt after that forme of ſome 30. or 40. yards on all ſides, as you ſhal ſee it demonſtrated in greater Forts, having three, or four, or five, or ſix ſtreets, according to their angles, to goe from the place to the Rampiers, becauſe all things in a Redout are to be as orderly carryed as in a Royall Fort, for all the difference that is to be betweene them, is in their extent, the Redouts extent being ſmaller then of a Royall Fort, or Citadell.

Now concerning the ſuperficies of theſe five redouts demonſtrated in plate foure; the firſt being the figure 24. is a perfect ſquare ſet out by the out-ſide of the circle; the ſides of the ſquare are of one hundred yards a piece. It is fortified by foure halfe moones, whoſe baſes are of fifty yards a piece to agree with the foure angles of the ſquare, whoſe ſides flank the halfe moone, and the ſides of the halfe moones flanke them, ſo that a man cannot appeare at any point or ſide of it, but he may bee in danger of his life by the Muſquet ſhot.

Of the ſecond Redout.

The ſecond redout demonſtrated in figure 25. is alſo a perfect ſquare, ſet out by the out-ſide of a circle, of the ſame extent of the firſt, and fortified by foure great halfe moons that reduce the forme of it to a perfect corner cap; the utmoſt angles of the foure halfe moones extend themſelves twenty yards beyond the four angles of the ſquare, for the better flanking of the ſides and points of the ſaid halfe moones that flank one another very well. There is a ſmall redout erected at Grays-Inne-lane end much like after this manner; but her extent is too ſmall, and her flanke inviſible; and therefore no better then a plaine little ſquare redout.

Of the third Redout.

The third redout is a demy-Paralogramme, halfe as long again as it is broad; it is ſet out by the foure extrems of two circles, and fortified by foure halfe moones, whoſe baſes are of 75. yards a piece, the better to flanke the Angles of the Paralogramme that flanke the half moones; this redout for her extent requires three hundred men for her defence, for it containeth 150. yards in length and one hundred yards in breath; It is of a very convenient form to be placed before the comming in of a gate of a great garriſon Towne to command divers rodes, ſo

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the rode that traverse the same be winding like the letter *S*. comming in of one side of the exterior half moon, and going out on the other side of the interior halfe moone.

Of the fourth Redout. The fourth redout is a perfect circle divided in six equall half moones after the forme of a Sexagon; it is very well flanked of all sides; because the utmost Angles of her half moons extend themselves twenty five yards into the field, more then her circulary circumference, whereby it is of a greater continent then the other redout; the demy paralogramme excepted.

Of the fift Redout. The fift redout is a perfect square, set out by the out-side of a circle, and fortifyed by foure Avant-gards, at the foure angles of it; whose utmost angles extend themselves thirty yards into the field; the breast of the Avant guards are twenty five yards broad; just the quarter part of the base of the square, the face of the Avant guard is of the same extent, and the flank of twelve yards and half. If the 4. sides of this redout that are in this figure but one hundred yards a piece were of two hundred yards a piece, it would make a strong and well flanked Fort, so the utmost angles of the Avant guards extended themselves 60. yards into the field; and the breast to be of fifty yards, the flanks twenty five yards, and the face of the Avant guards of fifty yards. The Royall Fort neare Islington is much after this manner, only the face of his Avant guards are square, and doe not extend themselves farre enough into the field, and therefore not so regular, nor so defensible as this.

CHAP.

Chap. XI.

Of the two first Methods of Fortification in generall.

THe ſmall difference there is between theſe two firſt Methods of Fortification, by Baſtions without, and with Orillons, hath induced me to joyne them into one; for they agree in all their eſſentiall parts, but in two things, *viz.* in the Line of their Flanks, and in the having or not having Orillons. Firſt, concerning the Line of their Flanks, Mr. *Ward*, Mr. *Cruſo*, Mr. *Norwood*, and the Author of the *Enchiridion*, do make no difference at all between the Line of their Flanks; for in all their Modells and Superficies, they draw the Flanks of the Baſtions with, and without Orillons, all after one manner, that is, upon a ſtrait perpendicularie Line: But on the other ſide, they would have the ſide, or the Baſe, to be divided into eight parts, when they frame Baſtions with Orillons, and only into ſix parts when they frame Baſtions without Orillons, in both which points I maintaine they are miſtaken: Firſt, for the Line of their Flanks, if it be drawne as they propoſe, ſtrait and perpendicularie wiſe, the Flanks by this meanes are too much expoſed to the Enemies great batteries, and to the volleyes of their Musketiers ſhot, as ſoone as they have gained the Defendents Counterſcarp; and therefore to prevent this evill, I ſay it is better and ſafer to draw the Line of the Flanks of the Baſtions that are to be without Orillons, one eighth part more ſlope than ſtrait: As for inſtance, ſuppoſe the Line of the Flank to be fortie two yards, then are you (I ſay) to ſtraine that Line five yards and one quarter more ſlope towards the other Flank of the other Baſtion, then a ſtrait perpendicularie Line will afford; for theſe five yards make the ſhoulder of the Orillon, to jet more into the dike then otherwiſe it would do, being drawne ſtrait; and by this meanes this jetting out is a great ſafegard to the Flanks; for all that thick and maſſie peece of earth, of the ſhoulder with this jetty, muſt of neceſſitie be battered to duſt, before the Flanks can receive any hurt; whereas if the Line be drawne ſtrait, the Flanks lye open to the Enemies batteries, if the Baſtions have no Orillons, or this

Of the difference that is to be obſerved in the drawing of the line of the Flanks, vvhen you are to forme baſtions vvith, or vvithout Orillons.

jetting ſhoulder to defend them. This is clearly demonſtrated in Plate 7, where the Pentagon fortified by Baſtions is deſcribed better then it can be in the Triangle, Square, or Ovall formes. So that I conclude, that the Line of the Flank is to be drawne ſtrait, when you intend to forme your Baſtions with Orillons; and more ſlope by five yards and a quarter then ſtrait, when you intend to ſet out, or forme Baſtions without Orillons.

Of the error of dividing the baſe into eight parts, vvhen they intend to ſet out Baſtions vvith Orillons.

As concerning their dividing of the Baſe, or ſide of any Poligon, when they intend to frame Baſtions with Orillons, into eight parts; and only into ſix parts, when the Baſtions are to be without Orillons: I ſay it is ſuperfluous, except they will imitate altogether the beſt Italian method; that is, firſt to divide the Baſe into ten equall parts, and to allow foure parts for the two Flanks, and the other ſix parts for the Courtine, which they divide againe into eight parts, to take their Line of defence from the ſeventh firſt part of it. But if they intend to follow the Low-Countrey method, they are not to divide their Baſe, but only into ſix parts, becauſe the forming of the Orillons doth not take or ſhorten the Courtine at all, as it will be clearly proved in the next Chapter.

Chap. XII.

Of the Fortifications of the Equilaterall Triangle by Baſtions with Orillons, demonſtrated in Plate 9.

The Equilaterall Triangle is fitter to be fortified by Avantguards then by Baſtions, becauſe her Angles be ſo acute, that they produce theſe defects in ſome eſſentiall parts of her Fortifications, her Flanks are ſhorter, the face of the Baſtions longer, and their Breſt narrower then they ſhould bee; and theſe defects cannot be avoyded, except the Line of defence be defective, that all Enginiers are to ſhun, as the moſt eſſentiall part of all; and therefore I have had ſpeciall regard to make that perfect, rather then to amend the other imperperfections. The Angle of her Center is of ſixtie degrees, her Angle

Angle flanked of fortie five degrees, and her Angle flanking of 160 degrees; her three ſi les are of 250 yards a peece, her circumference of 750 yards, and her continent from out to out, of 26230 yards; and therefore fitter for a large Redout then for a Royall Fort, for when wee have defalked the third part of her continent for the bredth of the Rampiers, the Market-place and the ſtreets, there will remaine but 17500 ſquare yards for the houſes of the Inhabitants, to everie one of which cannot be allowed in this ſmall continent, above one hundred ſquare yards, that is a peece of ground of ten yards ſquare on all ſides, and according to this ſcantling there will be 175 Inhabitants, that are according to the rules of war, to billet two hundred and fortie Foot, and a Troop of threeſcore Horſe, that is, for everie third houſe an Horſe-man, and for all the other houſes two Foot-men apeece, or otherwiſe 350 Foot, and no Horſe-men; for the continent is too ſmall for to billet Horſe. But 350 Foot, with the Inhabitants, commanded by a valiant Commander in chiefe, may defend the place three months, againſt an Army of foure thouſand men, ſo it be provided with all neceſſaries for a Siege.

To ſet out the ſame in the field, have a line of two hundred and fiftie yards, having a loop faſtened in the middeſt of it; and when you have made choyſe of the Seat, turne your ſelfe towards the South, and ſtraine your line from the South-Eaſt to the South-Weſt, and where the loop is, and at the two ends of the Line, knock in three ſtakes; then take a line of 210 yards, and faſten the ſame upon the middle ſtake, and ſtraine the ſame full North, and with a great woodden Square try (by ſetting one of the ſides of it to the firſt line, and the other ſide of the Square to the ſecond line) whether the laſt line be a perfect ſtrait perpendicularie line, and when it is ſo, knock in a ſtake at the end of the line. And theſe three out ſtakes will repreſent the three Angles of the Triangle, then take a ſix foot rule, and meaſure from the South ſtake along the perpendicularie line, ſeventie yards Northwards, and at ſeventie yards end knock in another ſtake, and it will repreſent the Center of the Triangle; for the Center of the Equilaterall Triangle is in the third part of the perpendicularie line of it, and not in the middeſt, as it is in all ſquare or circularie Superficies: then remove your line of 250 yards from one Angle-ſtake to another,

How an equilaterall Triangle may be ſet out in the field without a Demi-circle, or any Geometricall inſtrumeans but a Square.

The Center of the equilateral Triangle is in the third part of her perpendicularie line, and not in the middeſt, as the Center of circularie Superficies is.

ther, and then if you find them all of an equall distance, fasten small lines about them, and have the Superficie of the Triangle traced by many Pioniers, with pick-axes and spades; but if any of the Angle-stakes are not equall, you are to amend the errour by the line.

You may also set out the equilaterall Triangle by the Demy-circle, as I will give you directions in the next Chapter saving one, when I shall come to set out the Pentagon. In the meane time observe this for a generall rule, that the * gate or drawbride of a Redout, Fort, or Citadell, is alwayes to be full South, if the seat will permit; but howsoever it must be seated in the middest of a Courtine, that it may be secured by the Flanks of two Bastions.

* Note once for all, that the gate or drawbridge of a Fort is alwaies to be South, if the seat will permit, and in the middest of a Courtine, to be defended by the Flanks of two bastions.

The Superficie of the Triangle being traced, you are to divide the three sides into six equall parts, and at everie division to knock in a stake: then you are to fasten a line to the Center-stake, and to straine it Diagonall-wise towards the South-East and South-West Angle-stakes, and strait perpendiculary-wise towards the North stake, making the line thus strained touch everie one of these stakes; and you are to straine this line of 95 * yards beyond these three Angles stakes, for it is the distance that is to be between the Center of the Bastion of the Triangle, and the uttermost point of her Bastions, and at this distance knock in three stakes, and they will represent the three exteriour Angles of the three Bastions. Then fasten a * line to the third stake of everie one of the sides, and straine it till it be fastened one after another to these three Angle-stakes, and it will set out all the faces of the three Bastions, and all the six lines of defence; then fasten a short * line to all the second stakes of your sides, one time after another, and straine the same strait perpendiculary-wise, till they cut the other lines that represent the faces and the lines of defence, and where they cut one another, knock in six stakes, and they will set out the six Flanks of the three Bastions and the three Courtines; then have all these things traced by divers Pioniers, after you have fastened lines as neare the ground as you can to them all.

* This distance from the Center of the bastion to the point, is in this Triangle of 95 yards.

* This Line is to be of 240 yards long, the just extent of the Line of defence.

* This Line is to be fortie yards long, the just extent of the length of the Flank of this Triangle.

And that being done, you are to set out the six Orillons of the three Bastions after this manner; divide the Line of the Flank into

into three equall parts, and allow one part for the Flank, and in that part knock in a ſtake, and the other two parts for the turning of the Orillon; then you are to advance the ſhoulders of everie one of the Baſtions beyond the ſtake that did repreſent the end of the Flank and of the ſhoulder, ſeven yards; then you are to knocke in a ſtake, and to faſten a line of ſeven yards to the ſtake that repreſents the firſt diviſion of the Flank, and to ſtraine this Line parallel-wiſe with the former, and at the end of the Line to knock in a ſtake; then you are to divide the juſt diſtance of the bredth that is between theſe two laſt ſtakes, that will fall out to be thirteen yards and a third part, and in that diviſion you are to knock in a ſtake, and to that ſtake you are to faſten a line of thirteen yards & a third part, & at the end of it being ſtrained upon a ſtrait line, you are to knock in a ſtake; then you are to faſten your iron tracing pin to the other end of the line, and to draw with the point of it a circularie Line from one ſtake to another, touching as you paſſe by the verie laſt ſtake that you knockt in, repreſenting the extreame, or the middeſt of the circularie line of the Orillon; and by this meanes you will forme the Orillon perfectly, and verie round; and as you have ſet out this Orillon, ſet out all the other Orillons after this very manner: for this one direction will ſuffice once for all, for the ſetting out truly of a perfect Orillon.

Hovv a perfect Orillon is to be ſet out in the field.

By the ſetting out of this Orillon, the truth of the former poſition made in the laſt Chapter, *viz.* that the Baſe or ſide of any Poligon is not to be divided into eight parts, but only into ſix parts, whether you intend to erect Baſtions with, or without Orillons, becauſe the Courtine is not ſhortened at all by the forming of the Orillons; for the dike runneth between the Rampier of the Courtine, and the inward ſide of the Orillon, as it is clearly demonſtrated in this Triangle fortified by Baſtions with Orillons, the Courtine having the ſame extent as the other Triangle hath, that is fortified by Baſtions without Orillons, except you pleaſe to imitate (as I have ſaid) the beſt Italian method, that is perfectly ſet out in a demy Sexagon, in the laſt Plate of this Abſtract, where you ſhall find the Baſe to be divided firſt into ten parts, foure of which are allowed for the two demy gorges, and the other ſix parts for the Courtine, which Courtine is

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againe divided into eight equall parts, that the Line of defence may be taken from the firſt diviſion of the eight equall parts. And this they do to encreaſe the bredth of the breſt and of the gorge of their Baſtions, that they may be more capable of a ſecond, or a third re-intrenchment, when the Flanks, or the points of their Baſtions are beaten downe; but theſe Baſtions erected out of a Baſe divided into ſix equall parts, are reputed here to have their breſt and their gorge already too ſpacious, and therefore it were ſuperfluous to make them larger.

To conclude: The irregularitie of the Triangle cauſeth the dimenſions of her Baſtions to be theſe: The Flanks are fortie yards with the thickneſſe of the Orillons, the Courtines 166 yards, and two third parts, the Line of defence 240 yards, the breſt from out to out 90 yards, the whole gorge 80 yards, the face of the Baſtion of 120 yards, the Orillons 26 yards thick, and twentie yards long, jetting over the dike, that is a great preſervation to the Flanks; and the diſtance from the Center of the Baſtion to the point, is of 95 yards, the Orillons being ſet out: Then you are to ſet out all the dikes round about the Fort and Works, obſerving the dimenſions deſcribed in the Chapter, where is ſpoken of forraine Fortifications, caſting the earth of the dikes inward, to raiſe your Rampiers; and when all your inward works are finiſhed, and the broad dike perfected, then you are to ſet out the ſmall dike called *La Cunnete*, in the middeſt of the great dike, that you may make with the earth of it, the Counterſcarp round about the Fort, according to the directions before deſcribed.

*Hovv to erect the breſtvvork of the Counterſcarp, vvhen the great dike is full of vvater.

But if in caſe your great dike be full of water, and that it is impoſſible to dig the ſmall dike, to get earth to make your Counterſcarp breſt-work, you are to line the *great dike round about the Fort, at foure yards diſtance from the brim of the dike, and to dig that twelve foot diſtance a foot deep, and with that earth you are to erect the breſt-work of your Counterſcarp; that is (as I have formerly ſaid) to be ſix foot high, having one foot-ſtep of two foot broad, and eighteen inches high, being adorned on the in-ſide with good Turffe, and the out-ſide made ſlope to nothing, and levell with the ground, ſowne with hay-ſeed; and the twelve foot ſpace that hath been digged a foot deep, is to be levelled

levelled with an aſcent to the foot-ſtep of the breſt-work, falling towards the brim of the dike, that the raine-water may fall into the dike, and keep that ſpace and your works dry.

Chap. XIII.

Of the Fortifications of the Square by Baſtions with Orillons, demonſtrated in Plate 10.

THe ſquare is alſo irregulary, yet not ſo much as the Triangle, becauſe the Angle of his Center is of ninety degrees, his Angle flanked of ſixty five degrees, and his Angle flanking of one hundred forty ſeven degrees: and by theſe helps the faces of his Baſtions are not ſo long, their Breſt broader, and their exteriour Angle more Obtus, then thoſe of the Triangle, his foure ſides are of two hundred fifty yards a peece, his Circumference of one thouſand yards, and his continent from out to out of 62500. ſquare yards, out of which is to be defalked the third part, for the bredth of the Rampiers, the Market-place, and the Streets, and there remaineth for the lodgings of the Inhabitants and Souldiers, 41666 yards ſquare, and two third parts, and becauſe this continent is greater then the former, we will accordingly increaſe the ſcantling of the Inhabitants houſes, and allow them to be of 150. ſquare yards, that is a piece of ground of twelve yards and halfe ſquare of all ſides; by which ſcantling, the 41666. yards being divided, there will appeare to be in this continent 277. dwelling houſes, and as many Inhabitants, that may billet foure hundred Foot, and two Troopes of Horſe: and this number is ſufficient to maintaine this Fort againſt an Army of five thouſand men three months, ſo it be provided with ſixteen piece of Ordnance, Balls, Ammunition, Armes, Victualls, and all other neceſſaries, fit for a Siege.

Object. Some will wonder why ſo ſmall a Fort, ſhould have ſixteen pieces of Ordnance, when many of our Garriſons that are of two or three miles Circumference, have not ſo many.

Anſ.

Anſ. I anſwer the more is the pity, they are no better provided. But if this Method of Fortification were not better ſtored, to what end ſhould Forrainers be at the charges to erect upper and lower flanks: and becauſe I have not as yet ſpoken of theſe upper and lower flanks, I will upon this occaſion deſcribe how they are made, and for what uſe they are erected. In the Ancient Fortifications by Baſtions, there was formerly low Caſamates to ſcour the dikes even with the water, for they were built ſo low, that a Cannon being mounted in them and pointed, ſhot upon a levell Line, even with the water of the dike; and theſe Caſamates were all vaulted with arches of free-ſtone, having two Port-holes, and two Demy-Cannons, in every one of them, their vault being ſome ſixteen foot ſquare, and they had a ſlanting deſcent from the gorge of the Baſtion with a doore to come down to them, but becauſe they had no other light then the Port-holes, nor no other evacuation for the ſmoke, then the doore, when the Cannoniers fired their Pieces, they were ſo incumbred with the ſmoke in the vault, that they could not ſuddenly charge their pieces againe, but were inforced to ſtay till the evacuation of the ſmoke were paſt: Whereupon the moderne Enginiers to prevent theſe defects, have invented the upper and lower flanks, where they alwaies place two pieces of Ordnance in everie one of them, ſo that according to the Forrain Method, every Baſtion is to have ten pieces of Ordnance, at the leaſt, two Demy-Cannons in everie flanke, and two long Culverins to defend the faces and the point, that is in all ten pieces of Ordnance, theſe Flanks are made after this manner: The wall of the flanks is brought up from the bottome of the dike with free-ſtone of two yards thick, to the levell of the water of the dike, and within and without laid with Tarris, that the water of the dike may not pierce the ſame: and upon this wall and the firme ground, after another foundation of ſtone hath been laid, twenty four foot from the brim of the firſt wall, ſome five foot deep, a Breſt-work is brought up of earth and turfe, of twenty foure foot thicke in the bottome, and of twenty foot broad at top, and ſix foot high, having three Port-holes, and beyond this Breſt-worke the ground is digged lower the whole length of the flank, that is ordinarily from thirteen yards, to ſixteen yards in length,

Of the upper and lovver Flanks of a Baſtion.

length, and in breadth, eight yards, and in depth five foot, and this being laid with tracing and planked, is the Platforme of the lower flanke open over-head, in which they place two Demy-Cannons, and theſe ſcoure and free the dikes from the aſſaylants galleries, and from the ſcaling of the Rampiers. Now to erect the upper flank they go eight and forty foot wider into the gorge of the Baſtion, and upon the inward foundation of the lower flanke wall, and the earth of the Baſtion they erect another Breſt-work of the ſame height, breadth, and thickneſſe of the former, with three Port-holes in it, and then they planke another platforme and place two Demy-Cannons more upon the ſame, and theſe are the manner of their upper and lower flanks, that have a ſlope coming downe from the upper to the lower ſome ten foot broad, which being covered by the Orillons, make the Baſtions very ſtrong; and when theſe double flanks are taken out on both ſides, the gorge is not above fiftie yards broad, that is narrow enough for the laſt re-intrenchment. Now theſe flanks being all open over head, the ſmoke of the Ordnance is ſuddenly evacuated: the uſe of the upper Flank is to ſcoure the face, and the points of the Baſtions in the time of a ſtorme, and to beat all along the Courtine. And ſo much will ſuffice once for all, concerning the erection and uſe of theſe lower and upper Flanks.

Now I come to ſhew how you are to ſet out this Square in the field. If men could as ſoon and as eaſily ſet out a Superficie in the field, as they may upon paper, it were ſoone done; but this laſt requires a greater labour and care. You are then in the firſt place to make choyſe of your Center, and there to knock in a ſtake, then you are to ſtand cloſe to that ſtake, and turne your face full South, and then take your Demi-circle, and ſet the ſight of it upon the ray of 90 degrees, that is the Angle of the Center of the Square; then you are to have two men by you, one with lines and the other with ſtakes, and he with lines is to have a line of one hundred and * foureſcore yards, the one end of which line he is to faſten to the Center-ſtake; and when you have taken your Demi-circle, and ſet the ſight of it as afore-ſaid, you are to take with it, having your face turned to the South, the right hand ray of the Angle of 90 degrees, and when you have it, let the man

* You are to obſerve, that this line of 180 yards, is the juſt demi-diagonall line and diſtance that is betweene the Center-ſtake and the Angles of the Square.

ſtraine the line faſtened to the Center-ſtake along the ſaid ray, to the end of the line, and when he is juſt againſt you and the ray of your Demi-circle, let the other man knock in a ſtake at his feet; then turne your ſelfe, and ſet your Demi-circle to take the left hand ray of the angle of 90 degrees, and when you have it, let the man with the end of the line come to it, and when hee is juſt againſt you and the ray of your Demi-circle, let the other man with ſtakes knock in a ſtake at his feet at the end of the line, and theſe two ſtakes repreſent the South-Eaſt and the South-Weſt Angles of your Square; then turne your ſelfe full North, ſtanding cloſe to the Center-ſtake, and ſet out after the ſame manner the North-Eaſt and North-Weſt Angles of your Square, and let the man with ſtakes knock in two ſtakes, as hee did in the South ſide, and theſe foure utmoſt ſtakes will repreſent the foure Angles of the Square. Now to avoyd errour, you are to faſten the line of 250 yards with a loop faſtened in the middeſt, on the South-Eaſt ſtake, and to ſtraine it to the South-Weſt ſtake, if the ſtake be at the juſt diſtance of the line, that ſide is rightly ſet out; then you may knock in a ſtake where the loop is, to repreſent the middle of that ſide, where the gate and the draw-bridge of the Fort is to be placed; and ſo prove all the other three ſides with your Line of 250 yards, knocking ſtakes in the middeſt on everie ſide; for they will ſtand you in ſtead, when you come to divide the ſides into ſix parts. Now if any of theſe ſides be amiſſe, and agree not with your Line, then you are to amend them by your Demi-circle and your Line, which is eaſily to be done; and when the foure angles and ſides are right, you are to faſten lines to the eight ſtakes as neare the ground as may be, and to ſet Pioniers to trace the Superficie of the Square with ſpades and pick-axes, before you ſet out the Baſtions.

That being done, you are to divide the foure ſides of the Square into ſix equall parts, and to knock in a ſtake at everie diviſion, then you are to faſten a line of 90 yards to the former demi-Diagonall Line of 180 yards, that will then be of 270 yards, and to ſtraine the ſame * 90 yards beyond the foure Angle-ſtakes of the Square, after it is faſtened to the Center-ſtake, making the ſaid Line to touch the Angle-ſtake; and at the end of the ſaid line knock in a ſtake, and theſe foure ſtakes will repreſent the foure

* The diſtance from the Center of the Baſtion to the point, is of 90 yards in this Square.

foure utmoſt points of the foure Baſtions, and the foure former Angle-ſtakes, will then repreſent the Center of the Baſtions. This being done, faſten a line one after another to the third ſtake of everie ſide, of * 230 yards, and ſtraine the ſame to the foure ſtakes that repreſent the foure utmoſt points of the foure Baſtions, and this line will ſet out the eight faces of the Baſtions, and all the Lines of defence; then you are to faſten a line one after another of 41 yards and two thirds to everie ſecond ſtake of the foure ſides, and to ſtraine the ſame upon a ſtrait perpendicularie line till it come to cut the former line, that repreſents the line of defence, and ſets out the faces of the Baſtions; and where it cuts the other drive in a ſtake, and theſe eight ſtakes will repreſent and ſet out the eight Flanks and the foure Courtines: And that being done, you are to ſet Pioniers at work, to trace all theſe things before you go about to ſet out the Orillons.

* This Line of 230 yards is the juſt extent of the Line of defence of this Square.

* The Line of the Flanks in this Square is of 41 yards and two third parts.

Now to avoyd miſtake, you were better to ſet out one ſide at a time, & to have it traced as you ſet it out, for it wil ſave charges, becauſe it will not require ſo many lines. This being done, you are to ſet out the Orillons, and after the Orillons the dike; and when all is finiſhed, you are to erect the Breſt-work of the Counterſcarp with the earth taken from the ſmall dike, called *La Cunette*, adorning the ſame on the inſide with Turffe and a foot-ſtep, as I have formerly given large directions in Chap. 12. and Plate 9.

Chap. XIV.

Of the Fortifications of the Pentagon by Baſtions with Orillons, demonſtrated in Plate 11.

THe Pentagon is alſo irregularie, yet leſſe then the Square; for the Angle of his Center is of 75 degrees, and the Angle flanked of the ſame extent, and his Angle flanking of 142 degrees and a halfe, his baſes or ſides are of 250 yards a peece, his circumference of 1250 yards, and his whole continent from out to out of 125000 ſquare yards, it is of a convenient forme

for a Citadell, or of a well-compact Towne, whose circumference doth not exceed three quarters of an English mile.

* How you may know the continent of any Poligon with varietie of Angles.

Now to direct the Reader once for all, how he may speedily calculate the continent of all sorts of Angle Poligons, I have in this Figure set out a demonstration of it, viz. you are first to draw a strait perpendicularie from A to B, then a strait parallel line from C to D, and then to joyne D and A by a strait line, as it is demonstrated in this Figure, and it will produce a demy long square, his broad sides containing, according to the scale of this Figure, 200 yards, and his end-side 125 yards, which being multiplyed one by the other, it will produce 25000 yards, as the just continent of one of the Triangles of this Pentagon, which being multiplyed by five, (because it containes five Triangles, the whole continent will amount to 125000 square yards. Now the one third part of it being defalked for the bredth of the Rampier, the Market-place and the streets, there will remaine for the Inhabitants houses 83333 yards and a third part, which being divided by one hundred and fiftie square yards, that wee allow for everie Inhabitants dwelling house, that is a peece of twelve yards and an halfe square of all sides, it will according to this scantling containe 555 houses, and as many Inhabitants, that are according to the rules of war, to billet in everie third house a Horse-man, and in all the rest two Foot-Souldiers apeece; so that it will containe 185 Horse-men, 740 Foot-men, and 555 Inhabitants, a sufficient Garrison to defend this place against an Army of ten thousand men for three months; so it be provided with Ordnance, Armes, Ammunition, victuals, and all other necessaries for a Siege.

Now to set out this Fort in the field, you are to bring along with you two men, one with lines, and the other with stakes: and when you have made choice of your Center the man is to knock in a stake, and you are to stand close to this Center-stake, and having set the sight of your Demy-circle upon the ray of 75. degrees that is the Angle of the Center of the Pentagon, the man that carrieth the lines is to fasten a line of 240. yards to the Center-stake, and to straine the same full North upon a strait perpendiculary line, and at the end of it he is to knock in a stake and this stake represents the North Angle of the Pentagon;

* Note that this line of 240 yards is the extent of the demi-diagonall line of the Pentagon.

that

that done, take your demy-circle and wind the right hand ray to the right hand, the man holding in his hand the line of 240. yards, ſtraining the ſame according to the ray of the demy-circle, and when he is at the end of the line and juſt againſt you agreeing with the ray of your demy-circle, let the man with the ſtakes knock in a ſtake at his feet, and this ſtake will repreſent the North Eaſt Angle of the Poligon, then turne your face to the North-Weſt, and with the ray of your demy-circle on the left hand, the man with the line following the ſame, and when he is juſt againſt you and the ray of the demy-circle, being at the end of the line, the man with the ſtakes is to knocke in another ſtake at his feet, and this ſtake will repreſent the North Weſt Angle of the Pentagon. And after this manner ſet out the South-Eaſt and South-Weſt Angles of the Pentagon, and having knockt in ſtakes, theſe five utmoſt ſtakes will repreſent the five Angles of the Pentagon, and by theſe obſervations, the gate and the draw-bridge of this Fort will be full South, and in the midſt of the South Courtine, to be defended by the flankes of two Baſtions; when this is done, you are to take the line of 250. yards having a loop in the midſt, which line you are to ſtrain from ſtake to ſtake to prove whether your ſtakes are at an equall diſtance, driving at everie middle of all the ſides a ſtake, as you will be directed by the loop faſtened to the middle of the line: now if any of your ſtakes be amiſſe you may eaſily amend them, by the demy-circle, and the line, and when they are right, you are to faſten lines from ſtake to ſtake as neare the ground as may be; and ſet many Pioniers to trace the ſuperficie of this Pentagon, before you ſet out the Baſtions. And this is alſo the way how you ought to ſet out the equilaterall Triangle * by the Demy-circle, ſpoken of in the 12. Chapter, by driving a ſtake full North to repreſent the North Angle of the Triangle, and by turning your face South after you have ſet the ſight of the demy-circle upon 60. degrees, as being the Angle of the Center of the equilaterall Triangle, turning the ray of your demy-circle on the right hand, and then on the left hand, and driving at the end of the line of 250. yards two ſtakes, for by this meanes the gate and the draw-bridge of the Triangle Fort will be full South, and juſt in the midſt of the South Courtine, and defended by the flanks of two Baſtions.

* Hovv to ſet out an equilaterall Triangle by the demi-circle ſpoken of in Chap. 12.

The

The Superficie of this Pentagon being traced you are to divide the five ſides of it into ſix equall parts, driving in every diviſion a ſtake, then you are to faſten to the former line of 240. yards, another line of 83. yards, and a third, that is the juſt diſtance, from the Center of the Baſtion to the utmoſt point of it, and when you have done ſo, you are to faſten the ſame to the Center ſtake, and to ſtraine it diagonall-wiſe 83. yards and one third part beyond the five Angle-ſtakes, making the line as you ſtraine it to touch the ſaid ſtake, and at the end of the line to drive in five ſtakes, that will repreſent the five utmoſt points of the five Baſtions. And for the ſetting out of the reſt, I referre you to avoid repetition to the two laſt Chapters, where you had large directions to ſet out the flanks and faces of the Baſtions, with their Orillons, Dikes, and Conterſcarpes; and will onely acquaint you with the demenſions of this Pentagon, ſince I did omit the ſame in the ſquare, yet I will give a hint of them in this place: the flankes of the ſquare were but forty yards, and the flankes of the Pentagon are forty one yards, and two third parts, their Courtines are alike of 166. yards and two third parts, the diſtance from the Center to the point of the Baſtion, in the ſquare was 86. yards, and in this Pentagon of 83. yards; the gorge of the Square and of the Pentagon alike, of 83. yards and one third part.

And the line of defence in the ſquare 230. yards, and in the Pentagon three yards leſſe.

The faces of the Baſtions in the ſquare of 105. yards and in this Pentagon 100. yards, and the breſt in the ſquare of 95. yards, and in the Pentagon 100. yards.

Chap. XV.

Of the Fortifications of the Ovall by Baſtions without Orillons demonſtrated in Plate 8.

The Ovall is as irregularie as the Triangle, and one of the moſt difficult ſuperficies to ſet out in the field, becauſe of the circu-

lary

lary form, and the variety of the Angles, foure of them being of ſixty five degrees, and two, of thirty ſeven degrees and a halfe, the Angle flanking of 130. degrees, and the Angle flanked of 72. degrees and a halfe; her circumference is of 1500. yards, and her continent from out to out of 118800. yards; out of which the one third part being defalked for the bredth of the Rampiers, the market-place, and the ſtreets, there remains for the houſes of the Inhabitants 79200. ſquare yards, that is to be divided by 150. ſquare yards, for a piece of ground of 12. yards and halfe ſquare of all ſides, that is allowed to everie one of the Inhabitants, that are found to be by this calculation, 528. that are to billit 176. horſe-men and 704. foot-ſouldiers: A ſufficient Garriſon to oppoſe an Army of eight thouſand men for three months, ſo it be provided with Cannons, Ammunition, Armes, Victualls, and all other neceſſaries for a Siege. It is alſo a convenient ſuperficie, to fortifie a well-compacted market-towne, that may be reduced to this forme of three fourth parts of a mile Circumference.

Now to ſet out the Superficie in the field, you are to make choice of your Center, and to drive in a ſtake, and to faſten a line of 80 yards to that ſtake, and to ſtraine the ſame full Eaſt upon a ſtrait line, and to drive in a ſtake; then you are to wind the line about, and to ſtraine it full Weſt, and to drive in a ſtake, and theſe two laſt ſtakes divide the length of the Ovall into three equall parts, of 160. yards a piece, and repreſent the two Centers of the two circles, out of which the Ovall is formed, then you are to faſten a line to the Center ſtake of 220. yards, that is the extent of the demy-diagonall line of the South-Eaſt and North-Eaſt Angles, and of the South-Weſt and North-Weſt Angles, that are of 57. degrees and a halfe, upon the ray of which Angle, you are to ſet the ſight of your demy-circle and ſtanding at the Center ſtake to turne your face full Eaſt, winding the ray of the circle on the right hand, the man with the fore-ſaid line ſtraining the ſame till he come juſt againſt you, and the ray of the circle, then is the man that carrieth the ſtakes, to drive a ſtake at his feet, then you are to winde the ray of your demy-circle on the left hand, and to do as you did at right hand, and at the end of the line to drive in a ſtake, and theſe two ſtakes will

Note once for all, that you are to have a Sea-compaſſe, vvhen you go about to ſet out any kind of Superficies in the field, to place your angle South, North, Eaſt, and VVeſt rightly.

will repreſent the South-Eaſt and the North-Eaſt Angles of the Ovall, then you are to turne your ſelfe full Weſt, and to ſet out with your demy-circle, and the fore-ſaid line the South-Weſt and North-Weſt Angles, driving two ſtakes at the end of the line. Then you are to faſten a line of 160. yards * to the Center ſtake, and to ſtraine the ſame full South, upon a ſtrait line, and at the end of the line the man with ſtakes is to drive in a ſtake, then wind the ſame line about, and ſtraine the ſame full North upon a ſtrait line, and at the end of the line drive in another ſtake, and theſe two laſt ſtakes repreſent the South and North Angles of the Ovall: then remove this line from the Center ſtake, and faſten it to the Eaſt Center circle ſtake, & ſtrain it full Eaſt upon a ſtrait line, and at the end of the line drive in a ſtake, then remove the ſame line to the Weſt Circle Center ſtake, and ſtraine the ſame full Weſt upon a ſtrait line, and at the end of the line drive in a ſtake, and between theſe eight circularie ſtakes conſiſts the ſuperficie of the Ovall.

* This is the extent of the demi diametricall line of the bredth of the Ovall.

Now becauſe the ſix ſides of it are circularie, you are to remove the fore-ſaid line of 160 yards to the Center-ſtake, and to faſten your iron tracing-pin to one ſide of the line, and the other ſide to the ſtake, and to ſtraine the ſame full South, and to trace the ground as far as the line will give you leave, on both ſides of the South ſtake, and then you are to do the like on the North ſide; and that being done, you are to faſten theſe lines one after another to the Eaſt and Weſt circle Center-ſtakes, and to trace the Weſt and the Eaſt ſides of the Ovall with the point of your iron pin, as you did the South and North ſides, joyning the tracing of your pin on all ſides; and this being done, you are to ſet many Pioniers to make the tracing deeper with ſpades, or with the flat ends of their pick-axes.

And when this Superficie of the Ovall is ſufficiently traced, you are to divide the ſix circularie ſides into ſix equall parts, driving a ſtake in everie diviſion; then you are to faſten a line of 85 yards to everie Angle-ſtake one after another, and to ſtraine the ſame upon a ſtrait Diagonall line from the foure Angle-ſtakes that repreſent the South-weſt and North-weſt, and South-Eaſt and North-Eaſt Angles; but upon a ſtrait Diametricall line from the South and North Angle-ſtakes, and at everie end of the line you

you are to drive in a ſtake, and theſe ſix ſtakes will repreſent the ſix vtmoſt points of the ſix Baſtions; then you are to faſten a line of 240 yards to everie third ſtake of your ſix ſides, to ſet out by it the faces and the line of defence of the Baſtions, by ſtraining and faſtning this line to everie Angle ſtake twice to ſet out the twelve faces, then you are to faſten a line of 45 yards to everie ſecond ſtake of the ſix ſides or baſes, and to ſtraine this line not perpendicularie-wiſe, as you have done formerly, when you did ſet out the Baſtions with Orillons, but five yards more bevell, toward the next Baſtion, then ſtrait; and where the Line cuts the other that ſets out the faces of the Baſtions and the Line of defence, you are to drive a ſtake, and after this manner ſet out all the reſt, till you have gone round.

Now let me informe you once for all, that the ſafeſt and the moſt frugall way to ſet out your Baſtions after your maine Superficie is ſet out, is to ſet out one halfe Baſtion at a time, and to have it * preſently traced before you remove your Line; for theſe two Lines, one long to ſet out the faces and the Line of defence, and a ſhort one to ſet out the Flanks will ſerve turne; and beſides, it will prevent all confuſion and miſtakes.

* A generall obſervation to be noted.

Now when all the Baſtions are traced, you are to ſet out the dike; and when all is finiſhed, the Counterſcarp; as you have been directed Chap. 12, and 13.

The Line of defence of this Ovall is of 240 yards, the diſtance from the Center to the point of the Baſtion of 85 yards; and the length of the Courtine, becauſe of her circularie Line, of 170 yards; the breſt of the Baſtion, 110 yards; the Gorges of 83 yards and one third part; and the faces of the Baſtions of 100 yards, and others of 90, becauſe of the winding of the Ovall; and her Flanks of 45 yards, three yards longer then ordinarie, becauſe of the circularie line of the Courtine, that it may the better defend the inward Angle of the other Flanks.

The gates and dravv-bridges of this Ovall fortification are to be placed in the middeſt of the Eaſt and VVeſt courtine, that repreſents the length of the Ovall, and not South and North, as other Forts are.

CHAP. XVI.

Of the Fortifications of the Sexagon, by Baſtions with Orillons, demonſtrated in Plate 12.

THe Sexagon is regularie, and a moſt compleat Superficie, the Angle of her Center is of 60 degrees, the Angle flanked of 80 degrees, and the Angle flanking of 135 degrees; her ſides are of 300 yards a peece, her circumference of 1800 yards, her whole continent of 235000 ſquare yards; out of which the one third part being detalked for the bredth of the Rampiers, the extent of the Market-place and the ſtreets, there remaineth 156000 ſquare yards for the houſes of the Inhabitants, to whom wee will allow in this greater continent, 200 ſquare yards, that is a peece of ground ſome thing more then fourteen yards ſquare on all ſides: And after this allowance, the fore-ſaid number of 156000 ſquare yards, being divided by two hundred ſquare yards, it will appeare that this continent will containe 780 houſes, and by conſequence ſo many Inhabitants, that are according to the rules of war, to billet in everie third houſe a Horſe-man, and in all the reſt two Foot-Souldiers a peece: And after this accompt, there will be 260 Horſe-men, and 1040 Foot-Souldiers, a verie compleat Garriſon to defend a place not much above an Engliſh mile in circumference, ſo it be ſtored with Ordnance, Armes, Ammunition, victuals, and all other neceſſaries for ſuch a Siege.

I have in this Superficie, as being the laſt of this Method of Fortification, ſet out the broad ſtreets, that go round about the Rampiers, and from the Rampiers to the Market-place, that are to be ten yards broad, and the Market-place of an hundred yards in her Diametricall Line, and of the ſame forme of the Fortification of the Sexagon; for you are to obſerve in all new erected Forts, * Citadels, or Garriſons, to reduce the Market-place after the forme of the out-ſide works, to be the more compleat, *viz.* if it be an equilaterall Triangle, or a Square, or a Pentagon, the Market-place is to be of the ſame forme of a Triangle, or a Square, or a Pentagon.

* See in Chap. 18. vvhy theſe ſides have been ſet out fiftie yards longer then any other formerly have been.

This Sexagon is compoſed of ſix equilaterall Triangles equall on all ſides, containing everie one of them 39000 yards, vvhich being multiplied by ſix, containe 234000 ſquare yards.

* The Market place of a nevv erected Fort, Citadell, or Garriſon, is to be of the ſame forme of the out-Superficie of the vvorks.

Pentagon. Moreover, you are carefully to obſerve to line out in everie one of them, broad ſtreets of thirtie foot broad round about the Rampiers, and from the Rampiers to the Market-place, and theſe broad ſtreets that run from the Rampiers to the Market-place, are alwayes in this Method of Fortification, to be upon a ſtrait Diagonall, or Diametricall Line from the Center of the Baſtion, to the Center of the Market-place, as theſe are drawn in this Figure for theſe reaſons: 1 The ſtreets round about the rampiers ſerve for all manner of carriages to be brought to the works, and for the Horſe-men to ride to the releef of any of the rampiers in the time of a ſiege or ſtorm. 2 The great ſtreets that run from the *Market-place to the Baſtions, ſerve for a Troop of Horſe, of five of a breſt; or for a Company of Foot, with five or ſix men on a breſt, to come to the releefe of any of the Baſtions that are ſtormed. 3 The Market-place is always to ſerve as the Randezvouz for Souldiers to gather themſelves together, to be ſent by the Governour where occaſion requires. I have alſo ſet out the order that is to be obſerved in the erecting of the houſes for the Inhabitants, that are to be lined out with ſtrait double ranges, that gardens or back-ſides may joyne one againſt another, that houſes may have the more aire and light, and that all their doores may open to the ſtreets, that are to be fifteen foot broad; for narrow lanes are dangerous in Garriſon Towns. The Store-houſes or Magazines of Powder, Bullet, Fire-works, Engins, Ladders, Pioniers tooles; and proviſion of victuals, as Corn, Meale, Oat-meale, Oats, Malt, Hay, Salt, Powder Beefe, Bacon, Dry fiſh, Butter, Cheeſe, Rice, White Peaſe, and all ſuch neceſſaries, are to be in thoſe houſes ſeated round about the Market-place, as the moſt ſafeſt ſeat of the Towne.

* For vvhat uſe broad ſtreets lined round about the Rampiers and the Market-place, are erected.

All theſe obſervations are carefully to be regarded, if in caſe the State ſhould erect any new Forts, Citadels, or Garriſon-towns, where there never was any habitation before; for ſuch a new erected Hold would ten times be more ſerviceable then any old erected Towne in this Kingdome; (provided all the dimenſions of this Method be obſerved, that ſhall clearly be deſcribed in the Ichnography of this Chapter) becauſe they are for the greater part of deformed ſhapes, and of a vaſt extent, and not compacted together, nor their ſtreets well lined, nor ranged in order, nor

their houſes well contrived, ſome of them being verie high, and ſome verie low; but theſe of this new * erection are to be all alike, and not above two ſtories high, that may not exceed with with their roofe thirtie foot high at the moſt, that the ridge of the top of their houſes may be lower then the top of the Rampier Breſt-work by nine foot.

* Of the height of the newv-erected Houſes in a newv Fort, Cittadell, or Garriſon towvn.

Now to ſet out this Sexagon in the field, you are to make choice of the Center, and to drive in a ſtake and to faſten to that ſtake a line of three hundred yards, and a foot over, which line the two men that are alwayes to be with you to carrie your inſtruments, lines, and ſtakes, are to ſtraine full Eaſt, after you have taken with a good * ſea-compaſſe the Eaſt and Weſt points. But if by the long extent of the line the line ſwags and cannot be drawne ſtrait, they are to ſtraine it but one hundred yards verie ſtrait, and ſtiffe, and to drive in the ground verie deep a ſtrong ſtake, and to wind the line about it, then to ſtrain the line againe another hundred yards, and to drive in another ſtake as before, and to * obſerve to wind the line alwaies of one and the ſame ſide, and to make it come to be ſtrained againe, on that very ſide you did firſt wind it upon the firſt ſtake, to avoid all breakes; then you are to ſtraine the line again for the third time, and to drive in a ſtake, and this laſt ſtake will repreſent the Eaſt Angle of the Sexagon. Then your men are to untwiſt the line from the ſtakes and to wind it about to the Weſt point, and to ſtraine it and to drive in three ſtakes as they did before, and the laſt ſtake will repreſent the Weſt Angle of the Sexagon: Then you are to ſtake your demi-circle, and to ſet the ſight of it upon the ray of 60. degrees, and to ſtand at the Center-ſtake and to turne your face and demi-circle to the Eaſt ſtake, winding the ray of the demi-circle Eaſt and by South, then are your men to follow that ray with the line, driving at every hundred yards a ſtake, and when they are at the end of the line juſt againſt you, and the ray of your demi-circle of 60. degrees, let them drive in a third ſtake and it will repreſent the Eaſt and by South Angle of the Sexagon; then turne your ſelfe and your demi-circle Eaſt and by North, and ſet out after this verie manner the Eaſt and by North Angle, and when that is done, turne your ſelfe full Weſt, and ſet out after this manner the Weſt and by North, and Weſt and

* An Enginier is never to be vvithout a demi-circle, and a good Sea-Compaſſe.

* Obſerve to vvinde the line alvvaies of one and the verie ſame ſide of the ſtake, to avoid breaks.

by

by South Angles, and when all the six angle-ſtakes are driven in, then you are to remove your line from the Center ſtake, and to ſtraine the ſame from Angle-ſtake, to Angle-ſtake, to try whether your Angle-ſtakes, and ſides be equall, and to amend them if any be amiſſe, by the demy-circle and your line; and when they are all equall, then you are to faſten this three hundred yard line, one after another from Angle-ſtake to Angle-ſtake, as neare the ground as may be, and to ſet Pioniers to trace that ſide before you remove the line, and that ſide being traced, you are to trace the other five ſides, one after another, after the very ſame manner, before you undertake to ſet out your ſix Baſtions, that are to be ſet out after this manner.

Note that a good line of three double vvhip-cord vvound together of 300 yards and a foot, having loops faſtened at everie fiftie yards, and another coloured loope at everie hundred yards, vvill ſuffice to ſet out all this great ſuperficie.

When the Superficie of the Sexagon is traced, you are to divide your ſix ſides into ſix equall parts, that will be of fifty yards a piece, and to drive in everie diviſion a ſtake, then you are to faſten one end of your three hundred yards line to everie one of the ſix angles-ſtakes, one after another, and to ſtraine the ſame into the field one hundred yards beyond the * Angle-ſtakes, according to the former rowes of ſtakes you did drive in, whether the lines of them were diametricall or diagonall, and theſe ſix ſtakes will repreſent the ſix vtmoſt angles of the Baſtions; the ſix former Angles of the ſides of the Sexagon, being by theſe laſt ſix ſtakes become the Center of the Baſtions. Then you are to faſten one end of your long line to the third ſtake of every ſide, and to ſtraine and faſten the ſame to the ſtakes that repreſent the utmoſt points of the Baſtions, and for the firſt, we will ſuppoſe to be the Eaſt Angle, then faſten a line of 50. yards to the ſecond ſtake of the Eaſt and by South ſide, and ſtraine it perpendicularie wiſe till it cut the long line faſtened to the third ſtake of the ſaid Eaſt and by South ſide, on the right hand that is ſtrained and faſtened to the utmoſt angle-ſtake on the left hand of the Eaſt and by South ſide, and where this ſhort line cuts the long line, drive in a ſtake, for that ſtake binds the Courtine, and ſets out that flanke, and the long line that runs from the third ſtake and toucheth the Eaſt ſtake to the utmoſt point of the baſtion, repreſents the line of defence, and the face of the baſtion on that ſide, and to this face, and the flanke, you are to ſet Pioniers to trace the ſame, before you remove your lines, and this ſide being

* Becauſe the diſtance from the center of the baſtion to the utmoſt point, is in this Sexagon of 100 yards.

being traced you are to set out and trace after this verie manner all the eleven other sides, before you undertake to set out the Orillons.

The gates and drawy-bridges of this Sexagon Fortification are to be placed South and North, that they may be defended by the Flanks of twvo Bastions, and in the middest of the South Courtine, because the East and the VVest points have twvo Bastions.

For the setting out of which, I referre you to the 12. Chapter of this Abstract, where directions are described to set them out, and when the Orillons are set out, you are to set out the great dike, that is to be thirty yards broad, and ten yards deep, and the *Cunnette* five yards deep, and ten yards broad, and the Counterscarp is to be made with the earth taken out from this small double dike, called *La Cunette*.

To conclude, this second Method of Fortification, by Bastions with Orillons, is the best and the strongest that ever was invented, to fortifie all manner of Angle-Polligons, that are regularie, especially if the demensions contained in this insuing Ichnographie be observed.

The Ichnographie of the Sexagon demonstrated in Plate 12.

A represents the sides or base of the Sexagon, that are of 300. yards a piece.

B represents the Center of the Bastion, and the distance from the Center to the point of the Bastion, that is 100. yards.

C represents the Courtine that is of 200. yards.

D represents the faces of the Bastions, of 120. yards.

E represents the exteriour Angle or point of the Bastion.

F represents the circularie compasse of the Orillon.

G represents the Line of defence, by two prickt lines that is from 240. yards to 260. yards.

H represents the Flanks that are of 50. yards with the Orillons, but sixteen yards and halfe besides the Orillons.

I represents the jetty of the Orillons over the dike that is of 30. yards.

K represents the demy gorge that is of 50. yards.

L represents the whole gorge of the Bastion, that is 100. yards.

M represents the Brest of the Bastion, that is 140. yards.

N represents the Angle flanking of 135. degrees.

O represents

O repreſents the Angle flanked of 80. degrees.

P repreſents the Market-place, that is of 100. yards diameter.

Q repreſents the bredth of the dike that is of 30. yards.

R repreſents the Rampiers of 30. yards broad in the bottome, and 20. yards at top, becauſe the parapet of it with the three foot-ſteps take 30. foot of it, and the breſt-worke is nine foot high within ſide, and ſix foot without ſide, and twenty foot thick at top, with a ſlope of three foot.

S repreſents the broad ſtreets, that go round about the Rampiers and to the market-place that are thirty foot broad.

T repreſents the ſmall ſtreets that are of fifteen foot, and the rowes or ranges of the houſes of the Inhabitants.

Chap. XVII.

Of the third Method of Fortification, by Avant-guards and out-Guards, and halfe Moones in generall.

THe third method of Fortification would be as chargable as the ſecond, if we ſhould imitate in the erecting of it, the demenſions and proportions of the Italian and French Enginiers, or adorn them as they do with free-ſtone of all ſides to the *Cordeau*, or water-table, that is alwaies five yards higher then the firme or even ground, and ſometimes from the bottome of the dike, that are ordinarily 30. yards broad, 10 yards deep, and their Rampiers 20. yards broad, beſides the Breſt-workes, and three foot ſteps that are alſo 10. yards broad in the bottome, and 20. foot thick at top, their Rampiers being ordinarily brought up fifteen foot with ſtone-work from the even-ground and fifteen foot with turfe and earth, beſides the breſt-work of nine or ten foot high, that is in all ſome forty foot high, beſides the depth of the dike, and this they terme in the French Tongue, *Tels Rampars ſont hors de danger deſcallade*, that is, ſuch Rampiers are out of danger of ſcaling; and ſo they are, for ladders of fifty rounds, cannot be raiſed in the night time without noiſe, although

though they be made never ſo artificially, to be diſmounted or ſet up by ſcrewes in five or ſix peeces.

But ſince we have neither time, nor meanes, nor men, to man, to erect, or to finiſh ſuch great works, wee will reduce this third Method of Fortification, that is capable above all others, to endure without being much the worſe, alterations or diminutions in her dimenſions and proportions, to theſe enſuing ſcantlings.

The dikes are to be ten yards broad and five yards deep, not ſlope to nothing, as our Countrey ignorant Surveyours make theirs, more like hedge-dikes, then of Works and Fortifications; but only allowing a foot ſlope in everie yard; and by this meanes the broad dike when it is finiſhed, will be twentie foot broad, out of which is to be taken a ſmall dike of ſixteen foot broad, and eight or ten foot deepe, called by the French *La Cunnette*; and the ſlope of this dike is not to be on everie ſide above a yard, that it may remaine ten foot broad in the bottome; and theſe dikes are far better, and more difficult to be filled, or to be paſſed over, then thoſe that are not a foot broad in in the bottome, as I have already proved in Chap. 16.

And becauſe the great dike is no broader nor deeper than is above-ſaid, and that the earth that is to be digged out of the ſmall dike is to be throwne on the field ſide, ſome twelve foot beyond the brim of the great dike, for to erect when all the inward works are perfected, a Counterſcarp with a Breſt-work round about the Garriſon, of ſix foot high with a ſtep, wee will abſolately cut off from this forraine Method the whole Rampier, and erect only with Turffe, and the earth that is taken out of the great dike, a Breſt-work of twelve foot high within ſide, and nine foot high without ſide from the firme ground, leaving a water-table between the Turffe and the brim of the dike, of eight inches, if the earth be good; but if it be ſandy, or of a running clay, it muſt be left eighteen inches, or two foot broad, notwithſtanding the chat of ſelfe-conceited and ignorant men. The ſlope of the Breſt-work without ſide is not to be above a yard in three yards, if the earth be good; but if it be naught, a foot more will ſerve, ſo it be well filled and rammed at everie foure courſes of Turffe with ſmall bruſh bavins, as I have formerly given directions. And for the ſlope within ſide, it is ſufficient if it be

two

two foot in twelve, or one foot in six; for the three foot-steps are as a buttereſſe unto it. And the reaſon why the out-ſide of the Breſt-work is but nine foot, and the in-ſide twelve, is, that the Breſt-work is to be with five foot-ſteps, foure and thirtie foot in the bottome, and twentie foot at top, and ſo great a thickneſſe is to have at leaſt a yard ſlope to convey the raine-water away, and to make way for the Musketiers to cleare with their ſhot the brim of the dike. But in this place I will confute the groſſe ignorance and fooliſh frugalitie of ſome Countrey Surveyours, that ſet the inward wall of their Breſt-work upon looſe earth, in ſtead of bringing it up as well as the out-ſide from the firme ground, and all to ſave ſome few loads of Turffe, and a little labour; but this is a deſtructive frugalitie; for by it, within a yeare or two, all their Breſt-works cleave in the middeſt, and fall as much inward as outward. Now if theſe dimenſions and proportions be obſerved in this third, and in the fourth Methods, and the Faces, Flanks, and Angles of the Avant-guards, Out-guards, Halfe Moones, and ſmall Flanks truly lined and ſet out according to Art, our works ſhould not be an object of deriſion to Forrainers, as they are, and the charges would not have been greater then they have been, to erect our ſlight and ill-flanked Redouts, Scar-crow mounts, and ridiculous winding Angles as we have done, for it were better not to fortifie at all; but if we fortifie thus, we need not feare with Gods favour, to loſe our Garriſons as we have done, in eight and fortie houres.

CHAP. XVIII.

Of the extent of the ſides or baſes of all manner of Superficies, and of the juſt length of the Line of defence.

THe opinion of Enginiers doth varie much, concerning the extent of the ſides or baſes of any manner of regulary Superficie, that is to be fortified by Baſtious: * Mr. *Ward* would have it 900 foot, or 1000 foot at the moſt. The Italian Enginiers

* See his Animadverſions, Chap. 17. and pag. 49.

from 700 foot to 800 foot, and yet their foot is ſmaller then ours; and *Errard de Barleduck*, an ancient French Enginier, would have it from 600 foot to 700 foot: But Sir *Anthony de Ville*, and *Honorat de Meynier*, two later rare French Enginiers, would have the extent of it of 750 foot, that is 250 yards, and with their opinion I concur and aſſent: And to that end I have drawne all the ſides or baſes of the two firſt Methods, the Sexagon excepted, of 250 yards a peece, as the moſt convenient to reduce all the proportions of a Fortification by Baſtions, to a perfect dimenſion or ſcantling; but above all, the Line of defence to her true extent, and have only drawne the ſides of the Sexigon of three hundred yards a peece, to ſhew that Mr. *Ward* was as much out in that extent, as *Errard de Barleduck* was, in maintaining it ſhould be from ſix to ſeven hundred foot at the moſt; for if his opinion be followed, the Courtines and the Line of defence will be ſomething too ſhort, as it may appeare in all his Modells, and ſpecially in his regularie Angle Poligons, that exceed ſeven Angles. On the other ſide, if Mr. *Wards* opinion be followed, the Courtine and the Line of defence will be ſome thing of the longeſt, as it may appeare by the Sexagon demonſtrated in Plate 12. And therefore I conclude, that 750 foot is the beſt extent for the ſide or the baſe of any Poligon fortified by Baſtions.

Of the true extent of the ſide, to have the Line of defence from 200 yards, to 240 yards.

But as concerning the ſides or baſes of theſe two laſt enſuing Methods, by Avant-guards and ſmall Flankers, the baſes or ſides of all manner of Superficies may be (if you pleaſe) from five hundred, to two thouſand yards, ſo you obſerve in your diviſion, or in the placing of your Avant-guards and ſmal Flankers, two hundred and fiftie yards between Center and Center of everie one of them. But as for Forts that have no need to have neither Avant-guards, nor ſmall Flankers, but only in their Angles, you are then to obſerve carefully to make their ſides of no longer extent then of 250 yards a peece.

Now if any ſhould ſo much miſtake himſelfe, as to erect two or three Baſtions upon a ſide of 500 or 750 yards, theſe Baſtions are no more true Baſtions, but Ravelins; for it is improper for a Baſtion to be placed any where, but upon an Angle. Suppoſe then you would fortifie a Towne that containeth ſome three miles

miles circumference, that can be reduced in a circularie forme: if you will fortifie the ſame by 24 Baſtions, you muſt reduce this circularie forme into foure and twentie ſides, and as many Angles; but if you fortifie the ſame by Avant-guards, or ſmall Flankers, you need not to divide this circularie forme, but into eight ſides, and place in everie ſide two Avant-guards, and one halfe Moone beyond the dike, to defend the Angle; but if you fortifie the ſame by ſmall Flankers, then everie one of theſe eight Angles is to have a Flanker, and everie ſide two Flankers more, as it is demonſtrated in Plate 18, and 23. And this will ſuffice to have been ſpoken, concerning the ſides, or baſes of all manner of Superficies.

Concerning the Line of defence, * Mr. *Ward* is over-bitter againſt *Errard de Barleduck*, becauſe hee draweth his Line of defence from the verie corner of the Flank, and not from the third of the baſe or ſide which he calleth the Courtine. I do acknowledge that it is better to draw the Line of defence from the third part of the ſide or baſe, as Mr. *Ward* would have it, then from the corner of the Flank, and eſpecially if the ſides of the Fortification be of * 300 yards a peece, as Mr. *Ward* would have them to be; nay, it were better if it were drawne from the middle of the ſide or Courtine, (for it is one and the ſame thing.) To rectifie the errour of the extent of his ſides, of three hundred yards a peece, that makes the Line of defence unſerviceable for the muſket-ſhot, if the Line be drawne from the third part of the Courtine; whereas it would ſerve turne, and amend the errour of the over-long extent of the ſide, if it were drawne from the middle of the Courtine. Yet for all this ſmall errour of *Errard*, I ſee no reaſon why Mr. *Ward* ſhould be ſo bitter againſt him, for his owne Models are not without defects; for it is a verie good horſe that never ſtumbleth. And it is well knowne to all Artiſts, that *Errard de Barleduck* was an experienced Enginier, and the firſt that adorned the Art of Fortification in the French tongue. Beſides, the Line of defence is better (in the Superficies of the equilaterall Triangle, and of the Square) to be taken from the corner of the Flank, then from the third part of the ſide or Courtine, becauſe it openeth the breſt of the Baſtion, and maketh their exteriour Angle more obtus, then when it is drawne

* See his Animadverſions, Chap. 30. and pag. 74.

* If a ſide is of 300 yards, it is better to drawv the Line of defence from the middle of the Courtine, then from the third part of it.

from the third part of the Courtine. Moreover, Mr. *Ward* doth wrong or miſtake *Errard*, and the other French Enginier, to alledge as he doth, that they relye moſt upon the musket-ſhot for the defence of the Courtines, faces, and points of their Baſtions, deſpiſing the defence of them by the Ordnance ſhot; the defence of the musket-ſhot being (ſaith hee) no defence at all, to empede the Aſſailant from caſting their galleries over the mote. But I ſay that Mr. *Ward* doth miſtake the meaning of *Errard*, and of the reſt of the French Enginiers; for they erect their lower Flanks, and provide them with Demi-Cannon; only to prevent the caſting of galleries over their mote: And for their upper Flanks, beſides the Demi-Culverins they place upon them, to defend the faces and points of their Baſtions, they place Muſketiers to diſcharge their ſhot continually, while their Demi-Culverins are charging againe, and ſo make uſe of Ordnance and of Musket-ſhot alſo, for the defence of them. Therefore I will conclude with the Aſſertion of one of the greateſt * Commanders of our dayes, that the extent of the Line of defence is the beſt, that is convenient for the Musket-ſhot, as well as for the Cannon-ſhot.

* See the Duke of Roan in his Perfect Captaine, Chap. 8.

Chap. XIX.

Of the Fortifications of the Superficie, in the forme of S. Michaels *Croſſe, fortified by eight Halfe-Moones, demonſtrated in Plate* 13.

THe Circumference of this Superfice is ſo great that it contains 3680. yards, that is two Engliſh mile, and one third part of a mile, and therefore fitter to fortifie ſome Corporation town then for a Fort, ſo it may be reduced to this forme; the Angles of the Center of it are of fifty five degrees, and the exterior Angle of the halfe-Moones are of ſixty five degrees, halfe of the faces of the halfe-Moones are of 250. yards, and the other halfe of 210. yards a piece, whereby they require to be defended by ſmall drakes, or facres, beſides the musket-ſhot, but if upon every point of the halfe Moones a platforme were erected

as

as they are moſt commonly in all Redoubts, or Forts after this manner, viz. the Angle upon which you intend to erect a platforme, is to be brought up twelve foot high from the ground, to be levell with the inward ſide of the Breſt-worke, and towards the towne ſlope nothing, and when it is ſo, you are upon the laſt courſe of turfe, to place a frize with ſharp picked quarters, of ſix foot long, four inches broad, and three inches thick, * jetting one yard over the dike and running a yard into the breſt-worke, that is to be raiſed ſo farre as the platforme goeth on both ſides, ſix foot higher then the other Breſt-work, in which Breſt-work the Port-holes are to be made two on every ſide, ſo that theſe Angle-Breſt-workes are to be 18. foot from the ground, having a frize as is above ſaid round about the Platforme to free it from ſcaling, to place two Sacres, & two Drakes upon everie platform, this Fortification being ſo provided, will be of great defence, and very offenſive to the aſſaylants, becauſe the halfe Moones flanke one another ſo well, that none can approach the ſides or the points of them, without great danger of their lives; but if the diametricall line of this Superficie were reduced leſſe by one halfe or the ſcale of it, brought from 30. yards to 15. yards, it would have been of a great defence, without Drakes or Sacres, by the muſket-ſhot onely. But I have purpoſely ſet out the ſame ſo large to ſhow how ſuch great ſides may be ſet out in the field, for they are farre more difficult to ſet out, then ſhorter demenſions.

* Seven or eight inches diſtance one from another.

Now to ſet it out in the field, you are to make choice of the Center, and to drive in a ſtake; then you are to have a line reddy of 330.* yards, having at everie fiftie yards a loop faſtened to it of one colour, and another loop of another colour faſtened to it at everie hundred yards, then you are to ſtand at the Center-ſtake, and to turne your ſelfe full South, after you have ſet out with your Sea-compaſſe as neare as you can to that diſtance, of the line, the South, North, Eaſt, and Weſt points, becauſe the foure ſides of your croſſe are of neceſſity to be lined ſo; then ſet the ſight of your demi-circle upon the ray of 55. degrees, and wind the ray of your circle firſt on the left hand, and let the man with the line faſten the one end of it to the Center-ſtake, and follow with the other end of the line, the ray of your demi-circle,

* This Line of three hundred and thirtie yards is the juſt Demi-Diagonall and Diametricall extent of the Line that is to ſet out the eight invvard Angles of this Superficie.

circle, and when he is one hundred yards diſtance from you, and juſt againſt you, and the ray of your demi-circle, let the other man that carrieth the ſtakes, drive in a ſtake at his feet, and twiſt the line once or twice about the ſtake, obſerving alwaies to make the line to come to be ſtrained againe on that very ſide,* that he firſt twiſted the ſame, to avoid breakes, becauſe the thickneſſe of a ſtake of two inches thick will cauſe a great break in the extent of three hundred yards, that being done, let him follow ſtill the ray of your demi-circle, and when he is another hundred yards diſtant from the laſt ſtake, and two hundred yards from you, but juſt againſt you, and the ray of your demi-circle, let the man with ſtakes drive in a ſecond ſtake at his feet, and winde the line about the ſtake as he did before, then let him go forward and ſtraine ſtill the line till he be a hundred yards more from the ſecond ſtake, and when he is juſt againſt you, and the ray of your demi-circle, let the man with ſtakes drive the third ſtake at his feet, and having twiſted the line about that ſtake as he did before, let the man with the line go forward 30. yards, and when he is juſt againſt you and the ray of the demi-circle, let the man with ſtakes, drive in the fourth ſtake at his feet, and betweene theſe foure ſtakes there will be 330. yards, and the laſt ſtake will repreſent the South-Eaſt inward Angle of the Croſſe; then you are to wind the ray of your demi-circle on the right hand, and to ſet out after the verie ſame manner the South-Weſt inward Angle, and having driven in foure ſtakes as before, you are to ſet out the other ſix Angles after the verie ſame manner as you have done theſe two, and when the eight Angles are ſet out thus, and ſtakes driven in them all, then remove the line of three hundred thirtie yards, and faſten another line to the Center-ſtake, of 250. * yards, and ſtraine it South-Eaſt diagonall wiſe, this line being the juſt moytie of the demi-diogonall and diametricall lines from the Center-ſtake to the utmoſt points of the eight halfe Moones, and at the end of it drive in a ſtake, and this ſtake repreſents the Center of the South-Eaſt halfe Moon; then remove the line from the Center-ſtake and faſten the ſame to the laſt ſtake, and ſtraine it againe diagnall-wiſe, and that ſtake will repreſent the utmoſt point of the South-Eaſt halfe Moone, then ſet out after the verie ſame manner the other ſeven Centers, and utmoſt points

* In ſides that are above one hundred yards, that require above two ſtakes, you are carefully to obſerve, to vvind the Line upon the ſtakes all of a ſide, to prevent breaks

* The extent of the Demi-Diametricall and Diagonall Line, from the Center to the vtmoſt point of the Halfe Moone, is 500 yards.

points of the halfe Moones. Now becauſe the ſides or faces of your halfe Moones are not equall, eight of them being 250. yards a piece, and the other eight but 210 yards a piece, you are to ſet out the eight longeſt firſt by faſtening a line of 250 yards one after another to the foure ſtakes, that repreſents the foure ends of the two diametricall lines of the prickt Square demonſtrated in this Plate, and to ſtraine this line eight times one after another to the utmoſt Angle ſtakes that repreſent the utmoſt points of the halfe Moones, and as you ſtraine it, faſten the ſame to the ſtakes as neare as you can to the ground, that the Pioneers may trace that ſide, or face of the halfe Moone, before you remove the line to another ſide, and one ſide being ſet out and traced, ſet out and trace all the other ſeven ſides after this verie manner.

Then you are to remove this line of 250. yards, and to faſten another line of 210. yards to the foure diagonall inward Angles Center ſtake, that are juſt oppoſite to the Angles of the prickt Square demonſtrated in this Plate, to ſet out the eight ſhorter ſides or faces of the halfe Moones after the very ſame manner as you did ſet out the longer ſides or faces, and theſe being alſo ſet out and traced, the ſuperficie of this Fortification will be perfected, then you are to ſet out the dikes according to the demenſions deſcribed in Chapter 17. and when the inward Works are finiſhed, then you are to erect the Counterſcarp with the earth that is taken out of the ſmall dike, called *La Cunnette.*

Chap. XX.

Of the Fortifications of the Paralograme, fortified by Avant-guards, demonſtrated in Plate 14.

THe broad ſide of this Paralograme is of 900 yards, and the end ſide of it of 450 yards, and all the circumference of it 2700 yards, that is, an Engliſh mile, and three fifth parts of a mile; for her continent I will not ſtand upon, becauſe it is not of a convenient forme to erect a new garriſon, but onely fit to fortifie ſome market towne, if need ſhould require; of which form there are many in this Kingdome, moſt of them being as long a-

gaine

gaine as they are broad: Yet let the Reader obſerve, that in caſe he be required to fortifie a towne that may be reduced to this forme, that hath her broad ſide of 700 yards, and her end ſide of 350 yards, that he may boldly undertake to fortifie the ſame after this manner, ſo he divide his end into five parts, and his broad ſide into ten parts, and doth reduce the reſt of the demenſions of the faces, breſts, flanks, courtines, and line of defence after the proportions of his ſides; for then the dimenſions of ſuch a fortifiation will be more complete then this, and altogether defenſible by the musket ſhot. But I have ſet out this ſo on purpoſe, to ſhew what may be done, when men are tied by the extent of a place, and inforced to omit to erect foure Avant-guards leſſe then they ſhould, to avoid charges. The Angle of the Center of her broad ſide is of 135 degrees, and of her end ſide of 45 degrees. This is the moſt frugall way that can be invented to fortifie a long town of ſo large an extent as this is; for it is almoſt a mile and three quarters in the circumference, her end ſide is divided into five parts, two of which are allowed for the breſt of the two end Avant-guards, that contain 90 yards apeece, and the courtine 270 yards: her broad ſide is divided into ten equall parts, two of which are allowed for the breſt of the Avant-guards, that are of 90 yards a peece, uniforme with the end of the Avant-guards, the foure Angle Courtines are longer then the middle Courtine by 120 yards, becauſe of the addition of the long Flank to everie one of them, that extend themſelves into the field 120 yards more then the vtmoſt angles of the Paralograme, the end and the middle Courtines are defenſible by the Musket-ſhot, becauſe they are between two Flanks, and alſo becauſe the Line of defence of the faces of the Avant-guards is taken from the middle of the Courtine, whereby the Line of defence cometh to be from two hundred and fortie to two hundred and fiftie yards; but the long Angle Flanks cannot ſufficiently be defended by the Musket-ſhot alone, without foure Drakes and foure Sacres, one Sacre and one Drake mounted upon everie one of the long Flanks, and with them, this Fortification will be of great defence: The ſhort Flanks are of 60 yards a peece, and the faces of the Avant-guards of 120 yards a peece, uniforme with the long Flanks.

To

To ſet out this Superficie in the field, you are to knock a ſtake in your Center, and to ſtand cloſe to it, and to ſet your ſelfe Eaſt, after you have ſet the light of your Demi-circle upon the ray of 45. degrees; to ſet out the Eaſt and by South, and the Eaſt and by North Angles, as you have been directed formerly, and then to turn your ſelfe Weſt, and to ſet out the Weſt and by South, and the Weſt and by North Angles; and theſe being rightly ſet out, and ſtakes knockt in them, your two broad ſides North and South cannot be amiſſe. But if it be an erected Town, take the juſt length on the broad and end-ſide of it, with a line of 100 yards, and ſet out your Angles with the Demi-circle accordingly: and divide your end-ſide into five, and your broad ſide into ten equall parts, and then ſet out your Avant Guards thereafter.

CHAP. XXI.

Of the Fortifications of the Equilateral Triangle fortified by Avant Guards, demonſtrated in Plate 15.

ALL the ſides of this Equilateral Triangle are equall, and contain 520 yards apiece, ſo that her circumference is of 1560 yards, that is an Engliſh mile wanting 64 foot; the Angle of her Center is of 60 degrees. I omit her continent, becauſe of her large extent, that is fitter to fortifie a well compacted town, that may be reduced to this form, then for a new Fort. Her ſides are divided into eight equall parts; two of which, are allowed for the two breſts of the Avant Guards, that contain 65 yards apiece; and the other ſix parts are divided equally for the three Courtines, that containe 130 yards apiece. Her long flanks are 100 yards apiece, and her ſhort flanks of 50 yards apiece, and the faces of her Avant Guards, are uniform to her long flanks, whereby they are alſo of 100 yards apiece. And by theſe dimenſions, it is apparent that this Superficie is a compact and compleat Fortification, becauſe all her Faces, Flanks, Courtines, and Angles, can be eaſily de-

fended by the Muſquet ſhot; her line of defence is taken from the middle of the Courtine, and by this meanes of 160 yards.

Yet let me inform the reader, that if he had occaſion to fortifie a town that might be reduced into this Triangle forme, although her ſides were from 520 yards apiece, to 750 yards apiece, that he may boldly fortifie the ſame after this manner, ſo he divide his three ſides into 8 equall parts; and doth proportion his Flanks, Faces, Breſts, Courtines, and line of defence, after this extent: for notwithſtanding this addition of 230 yards to every ſide of the Triangle, all the dimenſions of his fortification, will be defenſible by the Musquet ſhot.

Now to ſet out this Superficie in the field, you are to make choice of your Center, and to knock in a ſtake; and after to ſet the ſight of your Demi-circle upon 60 degrees, and to follow the ſame directions given you in plate 9 for the ſetting out of a Triangle fortified by baſtions. And becauſe theſe ſides are as long againe as they were, I referre you to the directions given you in chap. 19. for the ſtraining of a long line by knocking in at every hundred yards of it a ſtake. But if it be an erected town that you are to fortifie, after this manner, goe up to the end of the town where you intend the North Angle of the Triangle ſhall be, and turn your face South; and with your Demi-circle, when the ſight of it is ſet upon the ray of 60 degrees, ſet out the South-Eaſt Angle of the Triangle, cauſing the man with lines to ſtrain a line from the North Angle ſtake where you ſtand, to follow the ray of your Demi-circle; the man with ſtakes knocking at every hundred yards a ſtake, and by this plurality of ſtakes you may lengthen your line as you pleaſe, twiſting the ſame alwayes of one and the ſame ſide of the ſtake, till he come to the juſt diſtance of your ſide of the Triangle, whether it be five hundred and twenty yards, or 720 yards; and at the ſide of the diſtance, knock in a ſtake, and that laſt ſtake will repreſent the South-Eaſt Angle of the Triangle, then ſet out after this manner the South-Eaſt Angle, and knock in a ſtake at the ſame diſtance, that it may repreſent the South-Weſt Angle; then meaſure with a line of 100 yards, whether the diſtance between the South-Eaſt and South-Weſt Angle ſtake, is equall with the two other ſides; and finding it to be equall,

then

then is the Superficie of the Triangle perfected, that you are presently to have traced, by many Pioniers; but if there be any errour, you are to amend the same by your Demi-circle and your lines.

The Superficie of the Triangle being traced, you are to divide the sides into 8 parts, and at every division to knock 8 stakes; knocking in also a stake in the middle of every side, for it will serve to set out the faces of the Avant guards, and the lines of defence, allowing two parts to every Courtine, and two parts to the two brests of the Avant guards; and at every third stake of every side, you are to fasten a line of 32 yards and ½, and to strain it first on the right hand along the side traced; and at the side of the line you are to knock in a stake, and then you are to wind the same line on the left hand, and to straine it along the side traced; and at the end of the line you are to knock in a stake, and these two stakes will represent the breadth of the brest of the Avant Guards; the exteriour stake toward the Angles of the Triangle, representing the beginning of the long flank, and the inward stake toward the middle of the side, representing the beginning of the short flank, and as you have set out this first brest of the Avant Guard, you are to set out the other five after the same manner. That being done, you are to fasten a line of one hundred * yards to every one of the stakes that represent the beginning of the long flank, and to strain the same into the field upon a Diagonal line, taken from the midst of the Courtine or side opposite to it; and at the end of the line knock in a stake, and six of these stakes will represent all the utmost parts of the long flank, and set out the sides of them that are to be traced as you set them out: then fasten a line of fifty yards to every inward stake that represents the inward parts of the brest, and the beginning of the short flank, and straine the same into the field, parallel with the line of the long flank, and at the end of a line knock in a stake, and these six stakes will bound and set out all the short flanks that are to be also traced, as you remove the line from one stake to another. Then you are to fasten a line of one hundred and threescore yards to every one of the middle stakes of the side, and to strain and fasten the same one after another to the utmost stakes that represent the Angles or Points

* If you can strain a line from the middle stake of the side of 320 yards, that is the just distance; from the side opposite to every long flank, it would be the better; if not, this way will serve turn, so you stand with your Demi-circle. At the middle stake of the side to guide the end of the line of 100 yards, to the very out-most Point or Angle of the Avant Guard.

of the Avant Guards; and they will ſet out all the faces of the Avant Guards and the lines of defence; for they will cut the line of the ſhort flanks, and end at the point of the long flanks, and theſe faces are alſo to be traced before you remove this line from one ſtake to another: and theſe being all traced, you are to ſet out all the ditches, according to the dimenſions deſcribed in the 17 chap. of this abſtract. And when all the ditches and inward works are finiſhed, you are to ſet out the ſmall ditch called *La cunette* out of the great ditch, and with the earth of it to erect the breſt-work of the *Contre eſcarpe*, as it is deſcribed in chap. 17.

Here followeth the Itchnographie of this method of Fortification, but ſpecially of the fortifications of this equilaterall Triangle. The letter *A.* repreſents the Market place, that containes in extent one hundred yards on every ſide.

B. Repreſents the breſt of the Avant guards that are in this figure, but 65 yards broad.

C. Repreſents the Courtines that are in this figure, but 130. yards.

D. Repreſents the ditches that are 10 yards broad, and 5 yards deep, beſides the ſmall ditch called *La cunette*, that is 16 foot broad, and nine foot deep.

L. F. Repreſents the long flanks, that are 100 yards long.

S. F. Repreſents the ſhort flanks, that are 50 yards long.

F. Repreſents the faces of the Avant guards, that are in extent 100 yards.

G. Repreſents the broad ſtreet that goes round about the Rampiars, and from the Rampiars to the Market place, that are to be 30 foot broad.

H. Repreſents the places for the lodgings and the ſmall ſtreets, that are to be 15 foot broad.

I. Repreſents the middle of the South Courtine where the gate and the draw-bridge is to be placed.

K. Repreſents the breſt-works with his five foot-ſteps, that is 34 foot in the bottome, with the five foot-ſteps, and twenty foot at top; 12 foot high within ſide, and 9 foot without ſide, with a ſlope at top, from twelve to nine that is a yard; the five foot-ſteps are two foot broad, and eighteen inches high apiece.

CHAP.

CHAP. XXII.

Of the Fortifications of the ſquare, fortified by Avant Guards, and Out-Guards, demonſtrated in Plate 16.

THe foure ſides of this ſquare containes 400 yards apiece, and by conſequence the circumference of it is of 1600 yards, that is almoſt an Engliſh mile; the Angle of his Center is of 90 degrees; I will omit his continent, for it is fitter to fortifie a compact Market town, that may be reduced to this form, then for a Fort; it is to be ſet out after the manner as hath been deſcribed in Plate 10. And therefore I will only here inſert ſome directions how you are to ſet out the Avant Guards, and Out-Guards, by which it is fortified.

The ſquare being ſet out and traced, you are to knock four ſtakes in the midſt of the foure ſides of it, then you are to faſten a line one after another to theſe foure ſtakes of 125 yards, and to ſtrain the ſame upon a ſtrait perpendicular line from the Center ſtake, 125 yards into the field, and at every end of the line to knock in a ſtake, and theſe foure ſtakes will repreſent the middle of the faces of the foure Avant Guards; then you are to faſten a line of 41 yards ⅓. to the very ſame ſtakes whereon the line of 100 yards was faſtned to; that is, to be removed and put by: and this line of 41 yards, and ⅓. is to be ſtrained firſt on the right hand, and then on the left hand; upon the traced ſides of the ſquares, and at every end of the line you are to knock a ſtake; and having done ſo to all the four ſides one after another, theſe eight ſtakes will repreſent the breadth of the breſt of the foure Avant-Guards: that is of 83 yards, ⅓. for the Avant Guards are to be one third part longer then they are broad; then you are to faſten to every one of theſe laſt ſtakes, the former line of one hundred yards one after another, and to ſtraine the ſame paralel wiſe to the ſtakes that repreſent the middle of the face of the Avant Guards; and at the end of every line you are to knock a ſtake, and to trace that flanke of the Avant Guards, before you

remove the line to the other flanks ſtake; and having done ſo round, and knockt in eight ſtakes, all the flanks will be ſet out and traced: then you are to remove the line of 100 yards, and lay it by, and to faſten the former line of 41 yards, ⅓. to the utmoſt middle ſtakes, that repreſent the middle of the faces of the Avant Guards, and to ſtraine and faſten the ſame firſt to the right hand ſtake, and then to the left hand ſtake that repreſents the utmoſt Angles of the Avant Guards; but before you wind the line from the right hand, to the left hand ſtake, have that moity of the face of the Avant Guard traced, then wind the line on the left hand, and trace the other moity of the face; and as you have ſet out and traced that face of the Avant Guard, doe all the reſt after this manner: which being done, your foure Avant Guards will be perfectly ſet out and traced.

Then you are to ſet out all your ditches after the ſame dimenſions deſcribed in chap. 17. and to caſt all the earth inward; to erect your breſt-works and their foot-ſteps, of that height and breadth mentioned in the ſaid Chapter. And when all the ditches, breſt-works, and foot-ſteps are finiſhed, then you are to ſet out the ſmall ditch called *La cunette*, out of the great ditch; and with the earth that is taken from it, you are to erect the breſt-work with the foot-ſtep of it of your *Contre eſcarpe*, foure yards beyond the brim of the great ditch. Before you ſet out any of your Out-guards, that are not to be undertaken before the breſt-work and the ſlope of it belonging to the *Contre eſcarpe*, be fully finiſhed; only you are to leave a gate of 12 foot broad againſt the places where you are to erect your out-guards, and theſe gates are to be made up by ſo many ſtrong and ſufficient Turn-Pikes, well ironed, with iron pikes, and good haſps and locks: for by theſe you are to releive your Out-guards, or make your retreat, if you be driven from the Out-guards: all this being finiſhed, you are to ſet out the Out-guards after this manner.

The foure Out-guards againſt the foure Angles of the ſquare, are foure equilaterall Triangles or Halfe-moones of one hundred yards on all ſides, two of the ſides are to have a ditch of nine foot broad, and ſix foot deep; and their breſt-works of ſix foot high with a foot-ſtep, and the breſt-work at top is to be ſix foot thick, and in the bottome nine foot with the foot-ſtep. And

the

the other ſide towards the Angle of the ſquare is to be open, that the aſſailants may be diſcovered if they ſhould poſſeſſe themſelves of theſe Out-guards; the Points of theſe Triangles that are towards the Angles of the ſquare, are to be 16 foot diſtant from the brim of the ditch.

The foure ſmaller Triangles have their Baſe 13 yards longer then their two ſides that are to have ditches and breſtworks that are to be of the very ſame dimenſions of their former Triangles; their baſe is of 83. and their fortified ſides of 70 yards; the firſt defend the Angles of the ſquare and the flanks of the Avant Guards, and the laſt defends the faces of the Avant Guards; ſo that this fortification is compleat, ſtrong, and of great defence: the coming in is to be in the middle of the South Avant Guards, for the gate and the draw-bridge are flanked, and covered by one of the Halfe-moons.

CHAP. XXIII.

Of the Fortifications of the Pentagon fortified by Avant Guards, and Out-Guards, demonſtrated in Plate 17.

I Have formerly ſhown in Plate 11, how to ſet out the Pentagon in the field; to omit repetitions, I will onely give you ſome directions how to ſet out the Avant Guards, and the Out-guards of this Pentagon, becauſe this Fortification differs from the other. The Angle of the Pentagon is of 75 degrees, his five ſides are of 240 yards apiece, ten yards leſſe then the former; the circumference of it is 1200 yards, that is almoſt three quarters of an Engliſh mile, a very convenient form for a Royall Fort for the continent of it: it differs little from the other, becauſe the circumference of it is but 50 yards leſſe, and therefore I will referre you to Plate 11. only I will inform you that if the circumference of it were a quarter of a mile greater then it is, that it might be defended, being fortified after this method by a ſmaller number of men then the other could be, that is fortified by baſtions, with orillons.

When

When the Superficie of the Pentagon is fully ſet out and traced, you are to divide his five ſides, into three * equall parts, that will be of 80 yards apiece, and you are to knock in ſtakes in all their diviſions; then you are to divide the middle diviſion in two parts, that there may be a ſtake knockt in to repreſent the middle of every ſide. Then you are to faſten a line of 80 yards * to the South-Eaſt Angle ſtake, and to ſtrain the ſame full Eaſt upon a ſtrait line agreeing with the ſide, and at the end of the line knock in a ſtake; then remove that line and faſten the ſame to the North and by Eaſt Angle ſtake, and to ſtrain it as before, and to knock in a ſtake; then remove that line, and faſten the ſame to the North and by Weſt Angle ſtake, and ſtrain it as before, and knock in a ſtake; then remove the line and doe the like, to the Weſt and by North Angle, and as much to the Weſt and by South ſtake, ſtraining the line as is ſaid before; and at every ſide of the line knock in a ſtake, and theſe five ſtakes will repreſent the five out-moſt Angles or Points of the five Avant Guards. Then remove that line, and faſten a ſhorter line of * 40 yards to the ſecond ſtake of the South ſide, on the left hand South-Weſt; and ſtrain the ſame into the field perpendiculary wiſe, and knock in a ſtake at the end of the line, and this line will repreſent the ſhort flank of the South-Weſt Avant Guard: and as you have ſet out this ſhort flank, ſet out the other foure, and knock ſtakes at every end of the line, and theſe five ſtakes will repreſent the five ſhort flanks. Then faſten the former line of 80 yards to every one of theſe laſt ſtakes, one after another; and firſt of all to the South-Weſt ſhort flank, and ſtrain the ſame Diagonal wiſe, faſtening the ſame to the ſtakes that repreſent the out-moſt Point of the Avant Guard: and before the line be removed, ſet Pioniers to trace the ſame, and it will ſet out the face * of the South-Weſt Avant Guard; and as you have ſet out this face, ſet out the other foure, after the ſame manner. You are to obſerve, that if a line of foure hundred yards could be ſtrained from the South-Eaſt Angle of the ſide of the Pentagon, and faſtned to the outmoſt Point ſtake of the South-Weſt Avant Guard, that this Diagonal line that repreſents and ſets out the face, would be more perfect, for it would cut the end of the ſhort flank, and terminate it ſelfe at the

* Note by this that the breſt of the Avant Guard is 80 yards broad.

* Note that the greateſt flanks of the Avant Guards advance 80 yards into the field.

* The ſhort flank is forty yards.

* The line of defence is taken from the middle of the ſide or Courtine that is in this figure of 240 yards.

the end or point of the long flank; but this cannot be done conveniently: only when you ſet out theſe faces, ſtand with your Demi-circle at every Angle ſtake of the ſide oppoſite to the face you ſet out, and by the Diagonal ray of your circle, you may guide the line of the faces, to be ſet out as perfectly, as if a line of 400 yards had been ſtrained.

Now when you have thus ſet out and traced the five Avant Guards, with their faces, long and ſhort flanks; you are to ſet out all your ditches, after the dimenſions deſcribed in chap. 17. Caſting the earth of them inward, to erect the breſt-works and their five foot-ſteps of that height, breadth, and thickneſſe, there deſcribed. And when all your inward works, and the great ditch is finiſhed, you are to ſet out the *Cunette* or ſmall ditch out of the great ditch, and to erect with the earth that is taken out of it, the *Contre eſcarpe* breſt-work, diſtant from the brim of the great ditch foure yards, obſerving the rules and dimenſions deſcribed in chap. 17. and alſo five places of twelve foot apiece to be left open in the breſt-work of the *Contre eſcarpe*; to ſet five Turn-Pikes right againſt theſe five Halfe-moones here demonſtrated, which Halfe-moones you are to ſet out after your *Contre eſcarpe* breſt-work is finiſhed, placing the open ſide of them within 16 foot diſtance of the ſlope of your *Contre eſcarpe*, that there may be a cleare paſſage for horſe and foot to come to the Halfe-moones, without ſpoyling of the ſlope of the *Contre eſcarpe*, that the French call *glaſis*.

The five Out-guards of this figure are five Halfe-moones, that have one ſide longer than the other by twenty yards; * the long ſide is of 80 yards, and the ſhort ſide of 60 yards; their ditch is to be nine foot broad, and ſix foot deep; their breſt-work is to be 9 foot broad in the bottome, with the foot-ſtep; and ſix foot thick at top, having a foot ſlope; and their height ſix foot from the ground, and foure foot and a halfe from the foot-ſtep. The gate and draw-bridge of this Fort is to be in the middle of the South ſide, that it may be defended with the South-Weſt flank, and covered with the South Halfe-moon, marked with the letter *A*.

* And this muſt of neceſſity be obſerved, that the long ſide of the Halfe-moones, may cover the flanks of the Avant Guards.

CHAP. XXIV.

Of the Fortification of the Demi-Sexagon fortified by Avant Guards, and Out-guards, demonstrated in Plate 18.

THis Sexagon is of a large extent, for her sides are of 800 yards apiece, and by consequence her circumference is of 4800 yards, that is almost two English miles and a halfe; and therefore fitter to fortifie a good Corporation, then for a Citadell, or Fort: the Angle of her Center is of 60 degrees. And the same directions that were given you for to set out the Sexagon demonstrated in Plate 12. fortified by bastions with orillons will suffice, with the observations contained in chap. 19. *viz.* to knock in stakes at every hundred yards, when sides, or Diametricall, or Diagonall lines exceed 250 yards.

The Superficie of this Sexagon being then set out, and fully traced, as it hath been showne in the foresaid Plate; you are to divide every one of the Bases into three equall parts, that will be of 266 yards, and ⅔. apiece; and to knock in a stake at every division: then you are to fasten a line to the two inward stakes one after another of 60 *yards, and to strain the same first on the right hand; and upon the side traced and the end of the line you are to knock in a stake, then you are to winde the said line about on the left hand, and to strain the same upon a strait line upon the side traced; and at the end of the line you are to knock in a stake, then you are to remove the line, and to fasten the same to the other inward stake of that side, and to doe as you did before; and to knock in two stakes at the end of the line, and these foure stakes represent the breadth * of the two brests of these two Avant Guards, and the middle stake represents the Center of the Avant Guards. Then you are to set out the brest of the other ten Avant Guards of the other five sides, after the very same manner as you did these last.

* 60 Yards is the just moity of the brest of the Avant Guards.

* That is of 120 Yards broad.

And that being done, you are to fasten a line of 120 yards to every one of the exteriour stakes that represent the breadth of the

the breſts of the Avant Gnards, and to ſtrain the ſame into the field upon a ſtrait Diagonall line, derived from the Center ſtake of the Sexagon; that you are to guide by the ſight of your Demi-circle, ſtanding at the Center ſtake, while the man that carrieth your lines, straineth the foreſaid line into the field: and at the end of it, the man that carrieth your ſtakes, is to knock in a ſtake, and this ſtake repreſents the utmoſt Point of the long flank of your firſt Avant Guard. And as you have ſet out this long * flank, ſet out the other eleven that remaine. And that being done, you are to faſten a line of 60 yards to the inward ſtake of that Avant Guard, that repreſents the breadth of the breſt of it; and to ſtrain the ſame into the field parallelwiſe, to that of the long flank; and at the end of it, you are to knock in a ſtake, and this ſtake repreſents the utmoſt point of the ſhort flank of that Avant Guard. But obſerve * to trace the long and ſhort flanks before you remove the line to another ſtake, to avoid miſtake. And as you have ſet out this ſhort * flank, ſet out the eleven that remain.

* Note and obſerve, This courſe is to be taken, becauſe the Demi-Diagonal line of this Sexagon, from the Center ſtake to the utmoſt Point of the long flank, is of 680 yards; that is too long a line to be conveniently ſtrained.

* Theſe long flanks are of 120 yards apiece.

* Theſe ſhort flanks, are of 60 yards apiece

That being done, knock ſix ſtakes in the middle of the ſix ſides of this Sexagon, then you are to faſten a line to every one of them one after another of 240 yards, and to ſtrain and faſten the ſame firſt on the right hand ſtake that repreſents the utmoſt Point of the long flanks, and this line will cut the end of the line of the ſhort flank, and ſet out the face of that Avant Guard, and withall doth repreſent the line of defence; * but before you remove this line, you are to trace the face of this Avant Guard that extends it ſelfe from the ſtake of the ſhort flank, to the ſtake that repreſents the utmoſt Point of the long flank. Then you are to wind the very ſame line about, and to faſten it to the left hand inward ſtake that repreſents the utmoſt Point of that long flank, and to doe as you did before to the other on the right hand, and then the two Avant Guards of that ſide of the Sexagon will be perfected; and as you have done this ſide, doe the other five ſides after the very ſame manner.

* The line of defence is taken from the midſt of the Courtine, and the extent of it in this figure, is of 240 yards. And the extent of all the Courtines are of 186 yards ⅔ apiece.

When the twelve Avant Guards are thus ſet out and traced, you are to ſet out all the ditches of it, after the very ſame dimenſions ſet downe in chap. 17. Caſting all the earth inward, to

erect the breſt-works, and their five foot-ſteps; of that height, breadth, and thickneſſe; deſcribed in the aforeſaid chapter. And when they are all finiſhed, you are then to ſet out the ſmall ditch called *La cunette*, out of the great ditch, and with the earth that is taken out of it, you are to erect the breſt-work of of your *Contre eſcarpe*, with the foot-ſtep of it; the height of which is to be ſix foot high with the foot-ſtep from the ground, and foure foot and a halfe from the footſtep; and the top of it ſloped to nothing, and levelled with the frm ground, leaving ſix places of twelve foot broad to place ſix Turn-Pikes, right againſt the middle of the ſix Halfe-moons, that are to be erected after the breſt-works of the *Contre eſcarpe* are finiſhed; the diſtance between the breſt-work and the brim of the great ditch, is to be twelve foot at the leaſt; and theſe Turn-Pikes are all of them to be locked in the night, and ſerve to retreat or releive the Out-guards in time of a ſiege.

And when all this is perfected, you are to ſet out the ſix Out-guards, that are ſix Halfe-moones in the form of ſix equilaterall Triangles, that have all their ſides equall, of one hundred and forty yards apiece; their Baſe that lieth towards the *Contre eſcarpe* is to be open, and the ends of it 20 foot or 24 foot from the ſlope of the *Contre eſcarpe*; and the coming to the town and the going out, is to be by the South and North Halfmoon, marked by the letter *A*. For by this means the gate and draw-bridge will be ſecured and covered by the Half-moones; and the Horſe, Carts, or Foot that come to town, ſhall be inforced to wind about the ſaid Half-moon; and by it expoſed if they be enemies, to the muſket ſhot of them that keep the breſt-works of the Half-moones. Now to ſecure theſe Halfmoones from ſurpriſes, beſides the Sentinel Perdues, there is to be a ſmall Court of Guard in the midſt of them, and ſtrong Palliſadoes, with Palliſado gates; that extendeth from the Points or Angles, to the very breſt-works of the *Contre eſcarpe*. The ditches of theſe Halfe-moones are to be nine foot broad, and ſix foot deep; their breſt-work 9 foot broad in the bottome, with their foot-ſtep; and their height ſix foot from the ground, and foure foot and a halfe from the foot-ſtep; and their thickneſſe at top ſix foot, having a foot ſlope towards the ditch.

This

This Garriſon thus fortified, and manned with a thouſand foot and three hundred horſe, and provided with 24 peeces of Ordnance, Armes, Ammunition, Fire-works, and Victuals, and all other neceſſaries for a ſiege; will be able to oppoſe an Army of twelve thouſand men for 3 months. For to conclude, this method of Fortification, is as convenient for us in theſe times of civill diſtraction as any, for it is not of great charges, and requires leſſe men to man the ſame; and yet is ſafer and ſtronger three-fold, then our skare-crow Mounts: ſmall and ill flanked redouts, and winding Angles.

CHAP. XXV.

Of the fourth and laſt method of Fortification by ſmall Flankers in generall.

THis fourth and laſt method of Fortification is derived from the firſt; compoſed of Flanks, Courtines, and Baſtions, without Orillons; for they agree in their form, but diſagree in their dimenſions: the faces, flanks, and breſts of theſe flankers, being in a manner halfe as ſhort again, as thoſe of the Baſtions; & the extent of the Courtines of this method by *flankers; longer by forty yards, by reaſon of the narrowneſſe of their breſts. It was invented to ſave charges, both in the erection of the works, and in the manning of the Garriſons; for I know no manner of Fortifications that will require leſſe men to defend it, nor ſmaller charges to erect it, then this method: and therefore the more convenient for us to make uſe of it in theſe times of civill diſtractions, in which we want meanes and time to erect ſtrong, compleat, and permanent Fortifications, and men to man and defend them; yet I will informe the reader of this truth, that if this method of Fortification be ſet and lined out by a judicious Enginier, and the dimenſions of it here deſcribed, carefully obſerved; that it will be three-fold as ſtrong againe, and as permanent and regulary then the Mounts, weak redoubts, and ſlight winding

* A Flanker is properly a baſtard Baſtion, without Orillons.

Angles, uſed In theſe dayes. And that a valiant and experienced Governour in a Garriſon thus fortified, will be able to defend it with twelve hundred foot, and three hundred horſe, although it be of three mile and a halfe circumference; then he could doe one that I know, fortified with Mounts and winding Angles; with eighteen hundred foot, and three hundred horſe.

So much availeth the Art and the Method of Fortification in the defence of a corporation, and yet I dare affirm for a truth, that their charges have been greater, then if they they had erected ſuch works as theſe; with the very ſame dimenſions following.

1, The extent of the ſides or Baſes of this Method, are not to exceed two hundred and fifty yards.

2. The neck of their flankers is neither leſſe, nor exceeds in extent fifty yards.

3. The breſt of their flankers neither more nor leſſe then 60 yards.

4. The flanks of their flankers neither leſſe nor more then 25 yards.

5. Nor the faces of their flankers leſſe or more then fifty yards.

6. The Courtines between two flankers, is not to exceed two hundred yards.

7. Their line of defence is to be taken in this method from the middle of the Courtine, that it may not exceed one hundred and fifty yards. Nor the exteriour Angle of their flanker, be more acute then theſe are.

8. The line of their flanks is not to be drawn upon a ſtrait perpendiculary line, as moſt men uſe to doe; for this way is deſtructive to the flanks, and they being reduced to duſt, the Garriſon is loſt. But they are drawne one ⅛. part more ſlope toward the other flank oppoſite to it, that the ſhoulders of the flankers may be thicker; and jet or extend ſo much the more over the ditches, to preſerve the flanks.

9. All the ditches are to be in this method that hath no *Contre eſcarpe*, or Out-guards, thirty foot broad, and twenty foot deep; the ſlope of them is to be for every yard a foot

foot on every ſide, that the very bottome of them may be ſixteen foot, and ½, broad; for it is a diſparagement to make the ditches of Fortifications, and Martiall works, like the ditches of incloſed grounds; beſides, they are not ſo ſafe, becauſe they are ſooner filled in a ſtorme: and this manner of ditches ſavours over much, of the ignorance and ſelfe-conceitedneſſe of our country ſurveyers.

10. The breſt-works are to be twelve foot high within ſide, and nine foot without ſide; their in-ſide is to be carried up from the firm ground, as well as the out-ſide; and the five foot-ſteps within ſide are to be carried up after the breſt-work is finiſhed on both ſides; they are to be two foot * broad, and eighteen inches high. The ſlope * of the in-ſide wall is to be but a foot in ſix foot, becauſe the foot-ſteps ſerve inſtead of buttreſſes to that inward ſide; but the ſtep of the out-ſide wall is to be a foot in three; and a water table is to be left, of eight inches broad (if the earth be good) between the brim of the ditch; and the turfe of the out-ſide wall, if the ground be ſandy, or a running clay, it is to bee eighteen inches broad; notwithſtanding the chat of ignorant men. The bottome or foundation of the breſt-work is to be thirty five foot in the bottome, with the five foot-ſteps; and twenty foot broad at top, that it may be of Cannon proofe; and it is to have a ſlope towards the ditch of three foot: and for that purpoſe, the out-ſide wall is but nine foot, and the inward twelve foot; that the ſlope may be from twelve to nine. And obſerve once for all, that all the Angles of this method where you erect Platformes, are to have another breſt-work ſix foot higher then the reſt, in which you make your Port-holes; and that this breſt-work is to have a * friſe when it is twelve foot from the ground, made of wooden pikes ſharpe at one end of ſix foot long, and foure inches broad, and three inches thick, that are to be placed eight inches diſtant one from another; jetting three foot over the ditch, and running a yard into the breſt-works.

* Of the breadth and height of the five foot-ſteps, and of the breſt-works.

* the ſlope of breſt-work walls.

Of the water table of the breſt-works.

Of the ſlope of the top of the breſt works, and of their thickneſſe.

* Of the friſe of the Platform.

Theſe high breſt-works are at every foure courſe of turfe to be laid with bruſh, or bavin wood well rammed with the earth; if the erectors intend they ſhould be of continuance.

Having

Having ſo clearly expreſſed the dimenſions of this method of Fortification, I ſhall not need hereafter to ſpeak any thing at all of them, becauſe I have obſerved in theſe five Superficies following, theſe proportions related in their Sides, Courtines, Flanks, Breſts, Faces, Gorges, and Lines of defence; and ſo I come to the method it ſelfe.

CHAP. XXVI.

Of the Fortifications of the Octogon, fortified by ſmall Flankers; demonſtrated in Plate 19.

THe eight ſides of this Octogon, containes two hundred and fifty yards apiece; and by conſequence, the circumference of it is of two thouſand yards, that is an Engliſh mile; and the ¼. part of a mile. The Angle of her Center is of 45 degrees, it is to be ſet out in the field as the Sexagon, by the Demi-cirle and Lines; as it is deſcribed in Plate twelve, and Chapter 15. I will therefore only give you ſome directions how to ſet out the ſmall flankers, becauſe it is a new method of Fortification, that wee have not as yet given you any directions for.

When the Superficie of this Octogon hath been ſet out and fully traced, after the manner you were directed to ſet out the Sexagon; you are to divide all the ſides of it in two equall parts, and to knock in a ſtake * in every one of their diviſions; then you are to faſten a line of twenty five yards to every one of the eight Angle ſtakes one after another, and to ſtrain that line firſt on the right hand, and then at the left hand, upon a ſtrait line; upon the ſides traced on the left and right hand of that ſtake, and at the end of the line you are to knock a ſtake, and theſe two ſtakes will repreſent the two Demi-Gorges * of that flanker; then remove your line to another Angle ſtake, and doe as you

* From theſe middle ſtakes is the line of defence drawn, that is in this figure of 150 yards; and the Courtine 200 yards.

* The whole Gorge of the flankers is to be 50 yards.

you did before, till you have ſet out all the demi-gorges after that manner. Then ſet by that line, and faſten another line of fiftie * yards to every angle-ſtake of the ſides, and ſtraine the ſame into the field upon a ſtrait diagonall line, ſtanding at the center-ſtake with your demi-circle to guide the ſame, (becauſe the demi-diagonall line from the center-ſtake to the utmoſt point of the flank is of 380 yards in this Figure, and therefore too long to be ſtrained conveniently) and at the end of this line of fiftie yards drive in a ſtake, and this ſtake will repreſent the utmoſt angle or point of the ſaid flanker; and as you have done this, ſet out the other ſeven angles of the flankers after this verie manner; then you are to faſten a Line of 28 * yards to everie one of the ſixteene ſtakes one after another, that repreſent the Demi-Gorges of the Flankers, and to ſtraine it three yards more ſlope then upon a ſtrait perpendicularie Line, towards the other Flanker of that ſide of the Octogon, and at the end of the Line you are to drive in a ſtake. The reaſon why you ſtraine this Line three yards more ſlope then ſtrait, is to preſerve the Flankes from the Enemies batterie, that are other wiſe too much expoſed to be ruinated by it: when the Line of the Flank is drawne upon a ſtrait perpendicularie Line, you are alſo to obſerve that the ſtrait perpendicularie Line of the Flank is but five and twentie yards, and that theſe three yards are added to it, that the Flanks may be three yards more ſlope then ſtrait, becauſe a ſlope line in five and twentie yards extent, comes to be three yards longer then a ſtrait. And as you have ſet out this Flank, ſet out the other ſixteen after this manner, and drive in ſtakes in them all; that being done, you are to faſten a Line of 150 yards to the middle ſtake of every ſide, and ſtraine it firſt on the right hand, and then on the left, and as you ſtraine it, make it touch the Flank-ſtake, and faſten it to the ſtakes that repreſent the vtmoſt point of your Flankers, and this Line doth repreſent the Line of defence, and the * face of that Flanker; and before you remove the Line, have the face traced by the Pioniers, and this face extends it ſelfe from the Flank-ſtake to the ſtake that repreſents the vtmoſt angle of the Flanker. And as you have ſet out this face-ſtake, ſet out all the fifteene other; and they being ſet out and traced, your eight Flankers will be perfected. Then you are to ſet out all your dikes after

* The Line of fiftie yards repreſent the diſtance from the center to the point of the flanker.

*, 28 yards is the extent of the ſlope flank.

* The face of the flanker is to be 25 yards, beſides the three yards added to thicken the Angle of the ſhoulder.

the dimensions described in Chap. 25. And these directions for the setting out of the Flankers of all the other ensuing Superficies, shall suffice once for all, to avoyd repetitions. This Octogon thus set out, and the proportions of her Flankers thus observed, it will produce a strong, and a verie regularie Fortification, fit to fortifie a faire Market-Towne, of a mile and a quarter circumference, that may be reduced to this forme.

CHAP. XXVII.

Of the Fortifications of the Paralograme fortified by small Flankers demonstrated in Plate 20.

THis Paralograme fortified by 18. Flankers hath his broad sides of 1500. yards, and his end sides of 750. yards, for a long Paralograme is to be as long againe as broad, and a Demi-Paralograme one third part longer then it is broad; his Circumference is of 4500, yards, that is of two English miles, and one third part of a mile, a large Circumference for so small a Continent, for it containes from out to out but 1125000. square yards, whereas if there had been 750. yards added to his bredth to reduce it to a Square, it had contained 2250000. square yards, that is just as much againe; so much availeth in the Art of Fortification, to make choice of compact Townes for a Garrison, when a place of three miles, and two fifth parts of a mile Circumference can be fortified for one quarter part more of charges, then a Towne that is smaller by halfe, and all because of her ill forme; yet because there are many Townes in this Kingdome, of this forme, I have inserted two different kind of Fortifications for them in this Abstract; for his Angles if you take the Angle of the Center, of the end side, from the Center of one of the two Circles of which it is composed, you shall find it of 90 degrees, but if you take it from the Center of the Paralograme it self, you will find it is but of 45. degrees, and the Angle of his broad sides is of 135. degrees, a very open and obtus Angle. This Superficie

cie is eaſie to be ſet out upon paper, as you may ſee by this Figure; but becauſe it is more difficult to ſet out in the field, when the broad ſides of it are of ſo large an extent, I will here add ſome obſervations to my former direction given in Plate 14.

The beſt and the moſt ſpeedy way to ſet out ſo large a Paralograme in the field, is to make choice of your Center, and to drive in a ſtake, and to faſten a line to it, of 375. * yards, and to ſtraine it full Eaſt, and at the end of it to drive in a ſtake, then you are to wind that line about and to ſtraine it full Weſt upon a ſtrait line, and at the end of the line drive in a ſtake, & theſe two laſt ſtakes will repreſent the two Centers of the two circles, from which this Paralograme is compoſed. Then you are to ſet the ſight of your demi-circle upon the ray of 90. degrees, and to ſtand at the Eaſt circle ſtake, turning your face full Eaſt winding your demi-circle on the right hand to ſet out the South-Eaſt Angle, the man that carieth your lines following the ray of your demi-circle till he be five hundred and thirtie * yards and juſt againſt you, and upon the ray, then your man that carrieth the ſtakes is to drive in a ſtake at his feet, and with a line of 100. yards, that they are to ſtraine between them, let them caſt with it, if there be juſt 530. yards from that ſtake to the Center ſtake you ſtand at, if there be juſt ſo much, then is that Angle perfectly ſet out, but if the diſtance be greater or leſſe, they are to remove the ſtake, and amend it, you guiding them by the ſight of your demi-circle, then you are to wind your demi-circle on the left hand, to ſet out as you did this the North-Eaſt Angle; and that being ſet out and a ſtake driven in, you are to remove your ſelfe from that Eaſt circle Center ſtake, to go to the Weſt circle ſtake, and to ſet out with your demi-circle, the South-Weſt and North-Weſt Angles, after the very ſame manner as you did the former, and two ſtakes being driven in them, the foure Angles of the Paralograme will be perfected. Then you are to ſtand with your demi-circle at the middle Center ſtake of the whole Paralograme, and after you have ſet the ſight of it upon the ray of 135. degrees, you are to turne your ſelfe full South and to try whether your South-Eaſt and North-Eaſt Angle ſtakes are juſt of 135. degrees, which being ſo, that broad ſide is perfected, then returne your ſelfe full North, and try whether the

* This line of 375 yards is the fourth part of the diametricall line of the long ſide of the Paralograme.

* The ray of this line of 530 yards is the diagonall line from the center of that circle to the angle of the Paralograme.

North-East and the North-West Angle ſtakes are juſt upon 135. degrees, which if they be, then is the Paralograme perfect in all his foure Angles, then you are to ſtand at every Angle ſtake, one after another, and to faſten a line to them, of 250. * yards, and the man with the lines is to ſtraine the ſame from one Angle ſtake to another, drive in at everie end of the line a ſtake, till he hath gone round, guiding his ſtakes with the ſight of your demi-circle, that all the ſtakes may be upon a perfect ſtrait line, then you are to faſten lines as neare the ground as may be to theſe ſtakes and to ſet many Pioniers to trace out the whole Superficie of this Paralograme, and that being done you are to ſet out all the 18 Flankers one after another, as you were directed in the laſt Chapter.

* This Line of 250 yards is the diſtance that is to be betvveen the center of one flanker to the other center.

Chap. XXVIII.

Of the Fortifications of the Square fortified by ſmall Flankers demonſtrated by a Demi-Square in Plate 21.

THis Square fortified by twentie foure ſmall Flanks if of 6000 yards circumference, that is three Engliſh miles and two fifth parts of a mile. It is verie convenient to fortifie a great Corporation Towne that may be reduced to that forme, his continent is great, becauſe of the ſoliditie of his body, for it contains 2250000 ſquare yards. The Angle of his Center is of 90 degrees, and it is to be ſet out in the field after the verie ſame manner of the end-ſides of the Paralograme, deſcribed in the laſt Chapter, and his Flankers are to be ſet out according to the directions given in Chapt. 26. and therefore to avoyd repetitions, I will omit to ſpeake of theſe things, and will only ſet forth what number of Ordnance, Foot-Souldiers, and Horſe-men, will be required to defend a place thus fortified againſt an Army of twentie thouſand men, the circumference of it being ſo great as it is.

1 It requires to be provided with fortie eight Peeces of Ordnance

nance of all ſorts; for there cannot be leſſe then two upon everie Flanker, ſix Demi-Cannons to diſmount the Aſſailants Cannons, if they erect their batteries, twelve Demi-Culverins to hinder their approaches, and twentie foure Sacres and ſix Drakes to cleare the Courtines, with Balls and Ammunition ſufficient for theſe, to ſhoot ſix thouſand ſhot.

2 Everie Flanker with his Courtine requires to have for their defence fiftie men beſides the Cannoniers and Matroſſes, *viz.* twentie Musketiers at everie Flank, and ten more along the Courtine; for the Flanks are the maine defence; for the Flank being of 28 yards, everie one of them will have 4 yards ſpace to manage his Armes, and the Cannoniers eight yards at everie ſide to manage their Ordnance; and after this rate, 1200 Foot with the Inhabitant Trained Bands is ſufficient, and a Regiment of three or foure hundred Horſe, to make ſallies, and to bring in contributions and proviſions. And I dare maintaine, that a place of this extent fortified with mounts and winding Angles, will require as many more men to defend the ſame, as well as the leſſer number before cited can defend it, if it be thus fortified.

3 It is to be provided with great ſtore of Fire-works, with two hundred Ladders of all ſizes, with two hundred wheele-barrowes, and two hundred hand-barrowes, with two hundred new ſpades, two hundred ſhovels, and two hundred pick-axes, all new, beſides thoſe of the Inhabitants; and with ropes, flax, poles, and great ſtore of timber, with many woollſacks; for all theſe things ſerve to repaire and to ſtop breaches ſuddenly.

4 It muſt be carefully provided with Corne, Meale, Malt, Oat-meale, Peaſe, Oats, and ſtore of Hay and Straw, to fodder and releeve the Horſe, with great ſtore of Powder Beefe, Pork, Bacon, White Peaſe, Riſe, Butter and Cheeſe, and of all theſe ſuch a competent proportion, according to the number of the Inhabitants, and Souldiers there in the Garriſon, to ſerve them three months, for otherwiſe it availeth little to fortifie Townes.

Chap. XXIX.

Of the Fortifications of the 24 Angle Poligon, fortified by ſmall Flankers, demonſtrated in Plate 22 by a Demi-Poligon of twelve Angles.

BEcauſe the ſcale of this demi-Polligon is ſmaller then that of the laſt ſquare, ſome will ſuppoſe his ſides the Circumference, and Continent of it, to be leſſe then thoſe of the laſt Figure, but it is not ſo, for their ſides and circumference are equall, and the Continent of this laſt is ſo much greater, as the circularie forme doth containe more then the ſquare, which I could eaſily calculate if it did any wiſe concerne to be informed of it, but it concernes not, becauſe this large Superficie is fitter to fortifie a great Corporation already built then for a new-erected City, and therefore I do omit the calculation of it.

To acquaint you, that the demi-diametricall and diagonall lines of this ſuperficie are of a thouſand yards, and the whole as much more, that is an Engliſh mile, and the one tenth part of a mile, and therefore very difficult to ſet, by anie other way then by the demi-circle; the Angle of his Center is of 15. degrees, and it is compoſed of 24 Iſocele Triangles that have three ſides foure times as long as their Baſes, the Baſe containing 250. yards, and their ſides 1000 yards: the beſt and the moſt ſpeedy way then to ſet the ſame out in the field, is to drive in a ſtake in the Center of it, and to ſet out firſt of all theſe foure Angles, viz. the South, North, Eaſt, and Weſt Angles, for thoſe being perfectly ſet out, all the reſt will be the eaſier to be ſet out, by dividing everie quarter into five equall parts: Now how you are to ſet out theſe foure Angles, it would be ſuperfluous to relate, becauſe I have formerly given ſo many directions for it, and therefore I will referre you to the precedent Inſtructions ſet downe in Plate 12. and 19. I will then acquaint you, that if this Corporation or City that you are to fortifie after this manner hath no ſtreets nor gates, that are ſeated, or run ſtrait South, North, Eaſt and Weſt, that you are in ſtead of a ſtake to

ſet

ſet up a verie high pole, in the Center of the Towne, in manner of a may-pole, having a ſmall flag or a buſh at the top, except there be neare the Center of the Towne a high ſteeple, that you may ſtake by it your Angles from without the towne, and having ſet out and traced the ſuperficie of it, you are then to ſet out and trace one quarter of the Flankers, one after another, to avoid confuſion or miſtake, and then you are to ſet out all the dikes after that manner deſcribed in Chapter 17. and of the very ſame bredth and depth, and having done ſo, and your work being fully finiſhed, you are to provide this Garriſon with the like number of Ordnance, Foot-men and Horſe-men, Ammunition, Victuals, and all other neceſſaries for a ſiege mentioned in the laſt Chapter, and ſo it will be able having a valiant and experienced Governour to oppoſe (by Gods favour) an Army of twenty thouſand men for three months.

Chap. XXX.

Of the Fortifications of the mixt Superficie, fortified by ſmall Flankers, and three Redouts, demonſtrated in Plate 23.

THis Superficie hath ſix of her Angles regulary, and the other irregulary; the regulary are of 75. degrees, the irregulary ſides whoſe point terminates it ſelfe in the midſt of the Parallograme Redoubt, are reduced to the forme of a recteligne Triangle whoſe baſe is of greater extent then her ſides, the three Redoubts are ſo placed, to blind the deformitie that doth alwaies inſue upon the conjunction of regulary and irregulary lines, and for divers other conſiderations, the whole circumference of it is of three Engliſh miles, and a halfe, and will require 1600. foot, and 300. horſe, and 54. pieces of Ordnance, with all other neceſſaries for a ſiege, mentioned in Chapter 28. for to inable the ſame to oppoſe an Army of twentie thouſand men for three moneths.

It is to be ſet out not from the Center, but with the demi-

circle,

circle, ſtanding one hundred yards in the field beyond the walls, to take in all the Allowes that are neere to the walls: The ſteeple ſerving naturally as for the Center; having then ſet your demi-circle upon the ray of 75. degrees, you are to ſet out the ſix regularie Angles after the very ſame manner, as you have been directed to ſet out the Sexagon and the Octogon, in Plate 12, and 19. and in the midſt of the South-Eaſt and South-Weſt ſides you are to ſet out the two ſquare Redoubts, that will require for their defence two pieces of Ordnance, and 100. men a piece; and from the South Augles of thoſe two ſides, you are to draw two diagonall lines, that may terminate in the Center ſtake of the Paralograme Redoubt, turning the rod after a winding manner, as it is ſet out by the prick lines, this Redoubt will require two pieces of Ordnance, and two hundred men for her defence, and every flanker fifty men, for the defence of it and his courtine, theſe flankers are to be ſet out, after you have divided the eight ſides into three equall parts, according to the directions given in Chapter 26. and where the Platformes are erected in the Angles of the Redoubts, you are to erect your Breſt-work ſix foot higher then the other Breſt-works, that have five foot-ſteps, becauſe the Platforme is to be levell with the in-ſide Breſt-worke, that is to be twelve foot high, whereby the Breſt-workes of the Platformes will be eighteen foot high from the ground, obſerving in all Angles where you erect a platforme, to place upon the laſt row of turffe that reduceth your Breſt-works to be 12 foot high, a *frize of ſharp ſquare wooden pikes of ſix foot long, and of foure inches one way, and of three inches the other way, jetting out a yard over the dike, and running a yard into the Breſt-works, and theſe pikes are to be but eight inches diſtant one from another; now if this Garriſon were thus fortified, and provided, it would be one of the ſtrongeſt and one of the moſt compleat Garriſons in this Kingdome.

* Hovv the Frize of a platforme is to be placed, and of the diſtance betvveen the pikes.

OF

PLANS & SVPERFICIES

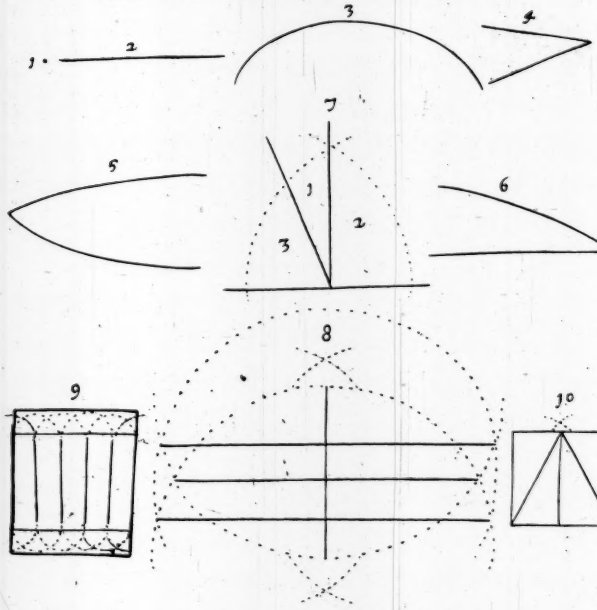
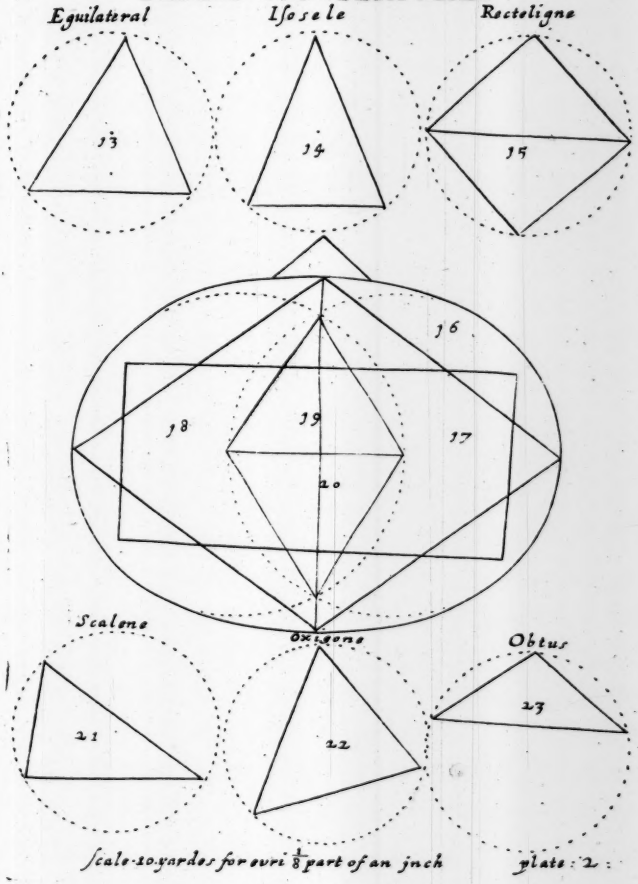


plate : 1 :

PLANS & SVPERFICIES



scale·10.yardes for evri $\frac{1}{8}$ part of an jnch

plate : 2 :

PLANS & SVPERFICIES

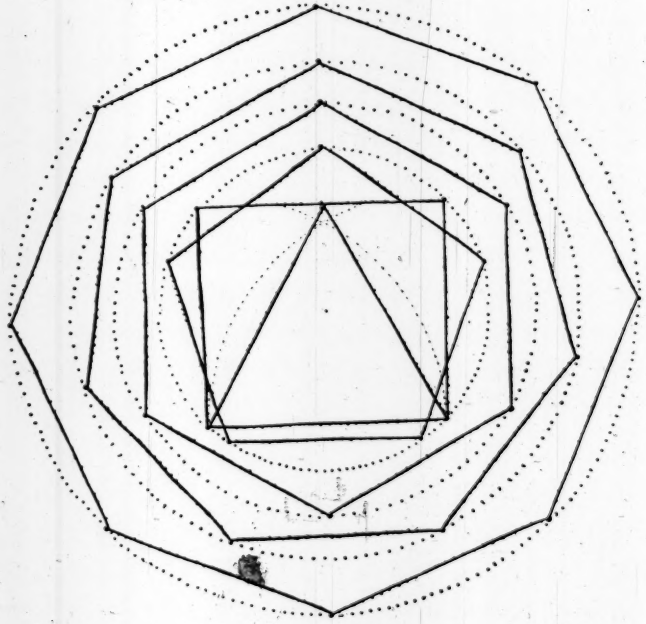
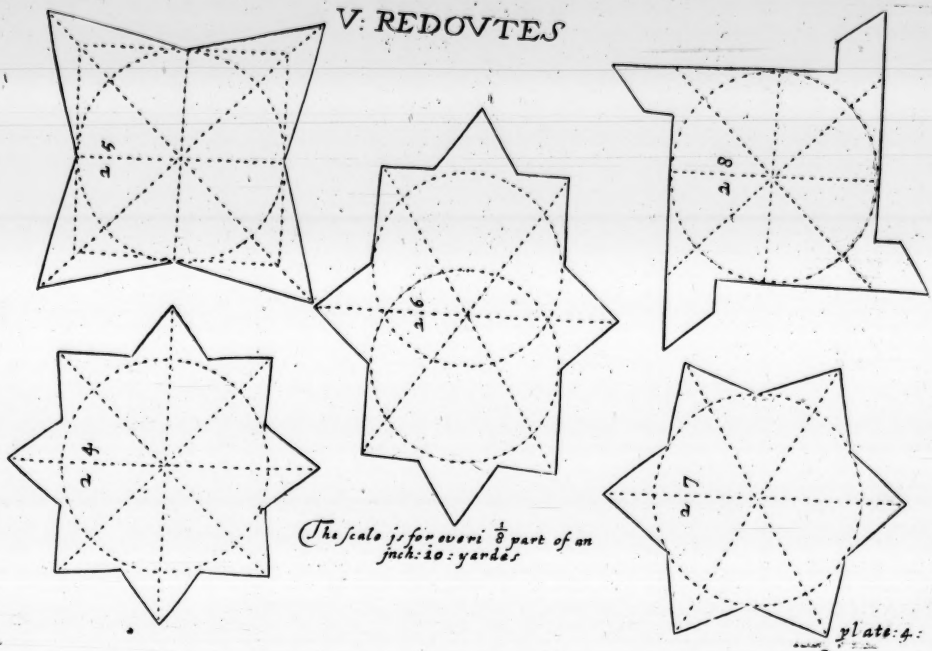


plate 3

V: REDOVTES



The scale is for every $\frac{1}{8}$ part of an inch: 10: yardes

yl ate: 4:

The scale of this Equilaterall Triangle is for everie $\frac{1}{8}$ part of an inch is 15 yards

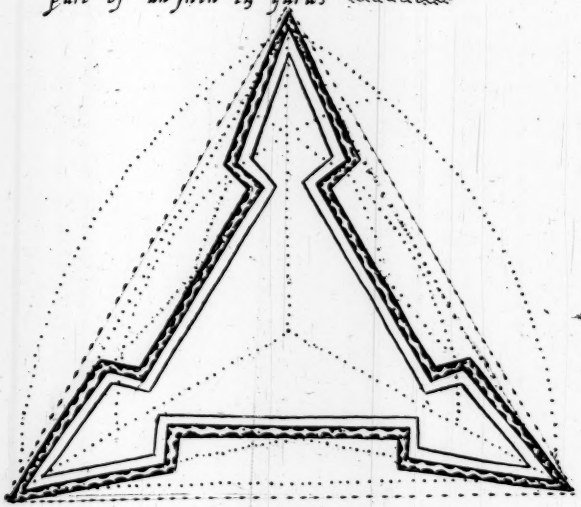


plate 15

A TRIANGLE

The scale is for every $\frac{1}{8}$ part of an inch 15 yardes

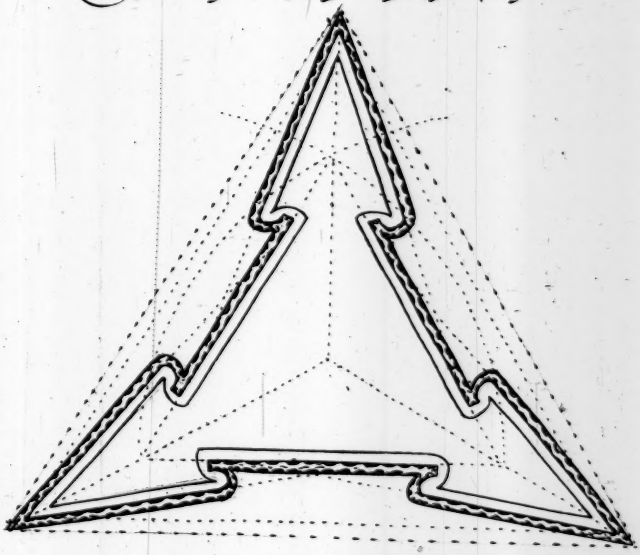


plate: 9 :

The scale of this Squaire is an $\frac{1}{8}$ part of an inch for 15 yardes

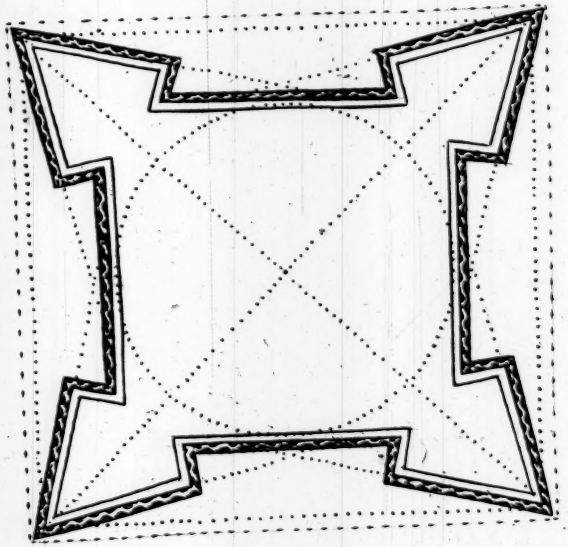
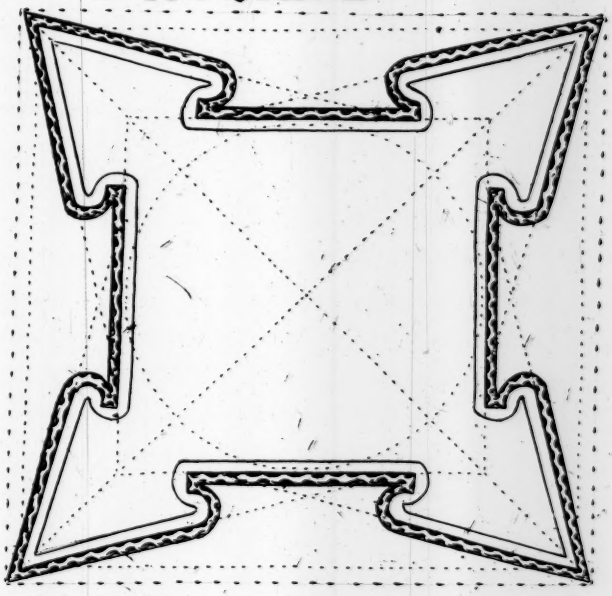


plate :6:

A SQVAIRE



The scale is $\frac{1}{8}$ part of an inch for 15 yardes

plate 30.

A PENTAGON

The scale is for every ½ part of an inch: 20: yardes

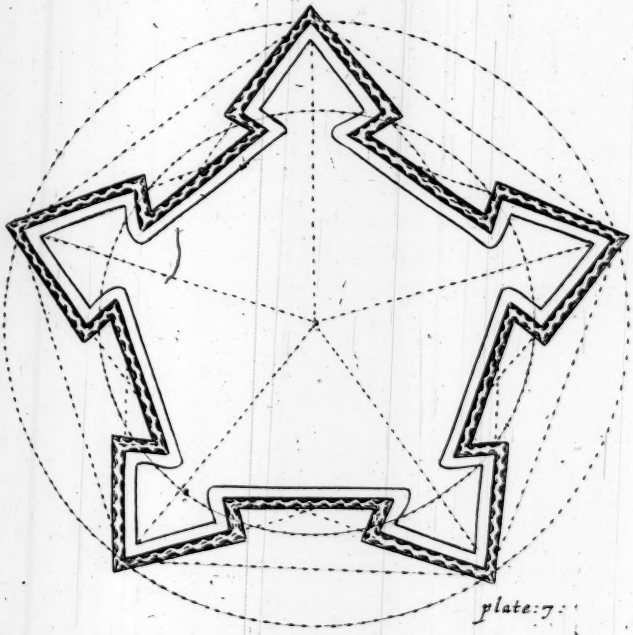


plate: 7:

A PENTAGON

The scale is for every ¼ part of an inch 20 yardes

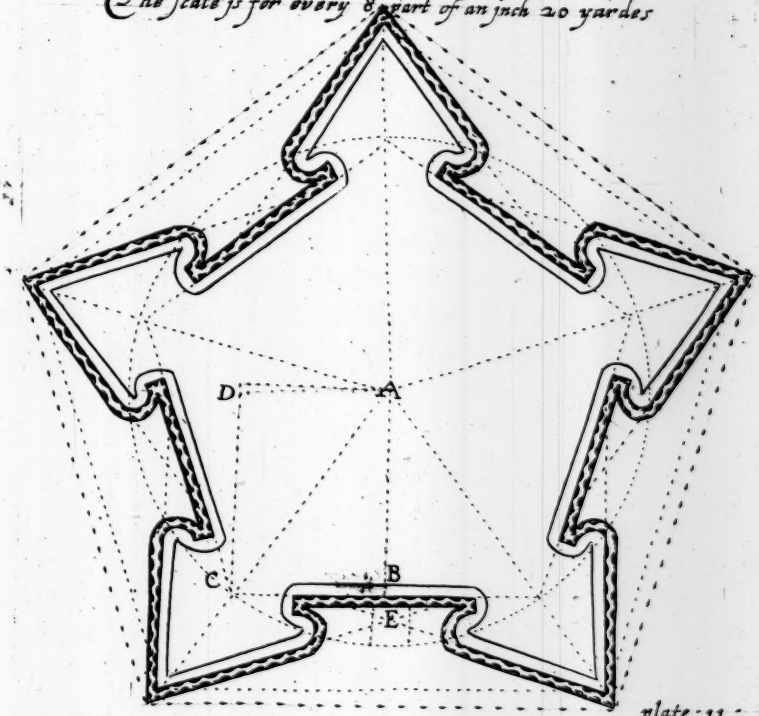


plate: 11 :

ANOVALL
Fortified with Bastions the scale is for ⅛ part of an inch 20 yardes

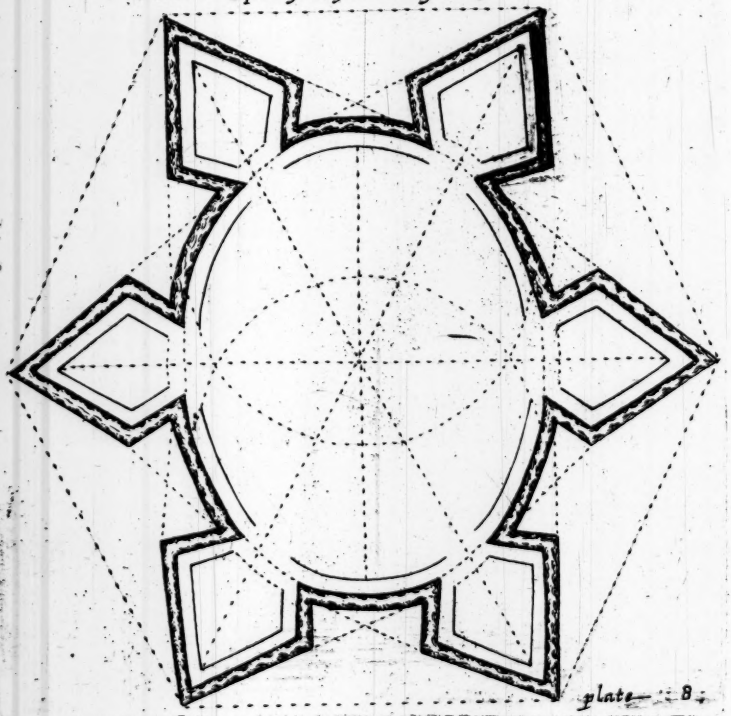


plate 8

A SEXAGON

The scale is for everie 8 part of an inch 20 yardes

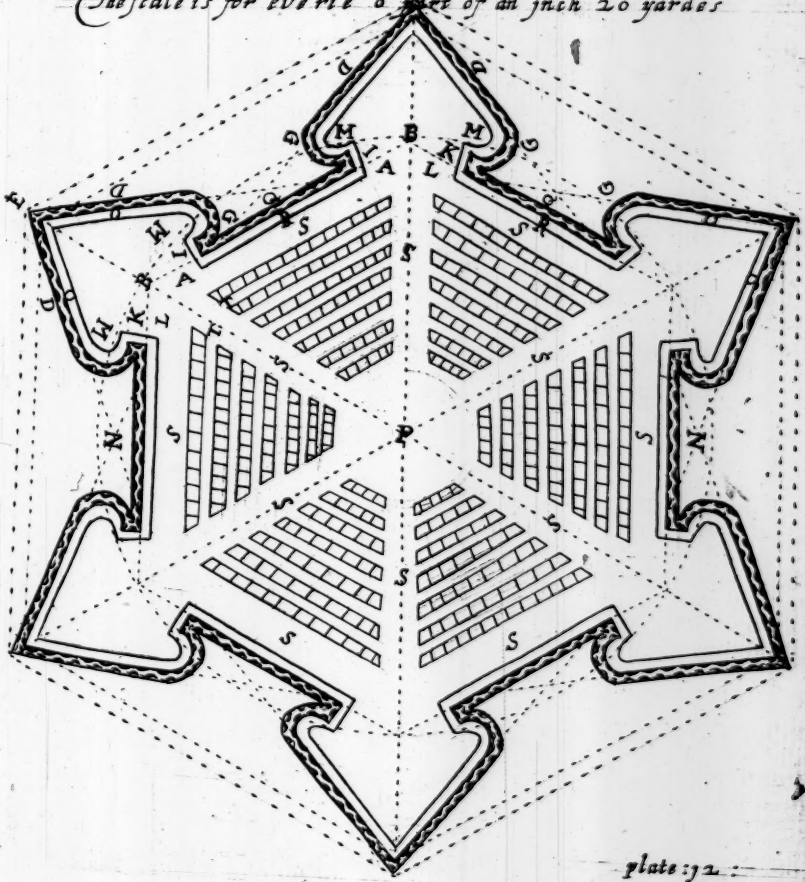


plate: 72

A Fort jn the forme of a Crosse fortified with 8 halfe moones, the scale 30 yardes for $\frac{1}{8}$ parts of an jnch.

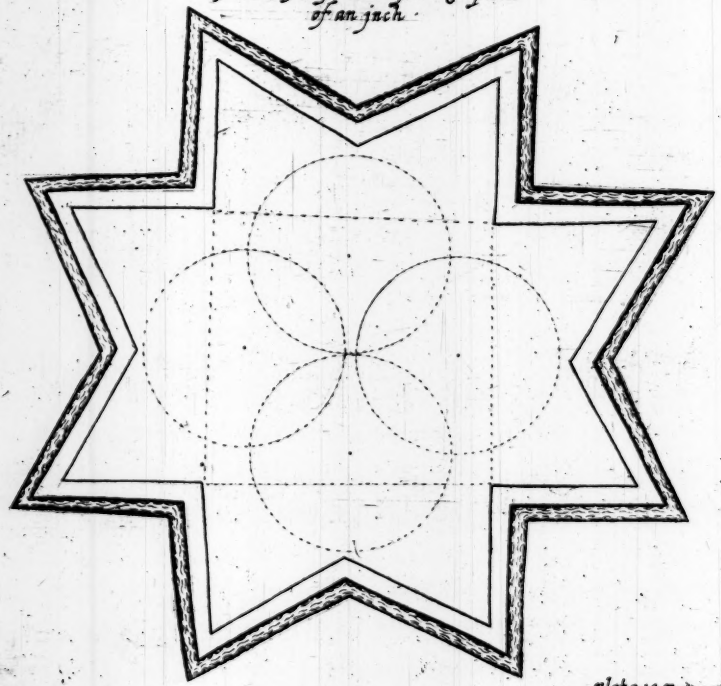


plate :13.

ALONG SQVAIRE

fortified with avant gardes, the scale is for everi $\frac{1}{8}$ part of an inch: 30: yardes

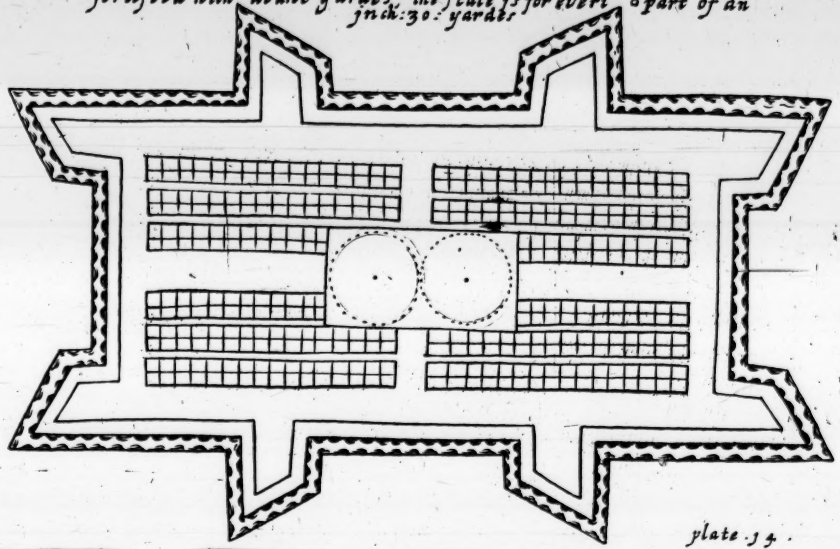


plate. 34.

A TRIANGLE

Fortified by Auant gardes the scale is 20 yardes for euery 8 part of an inch

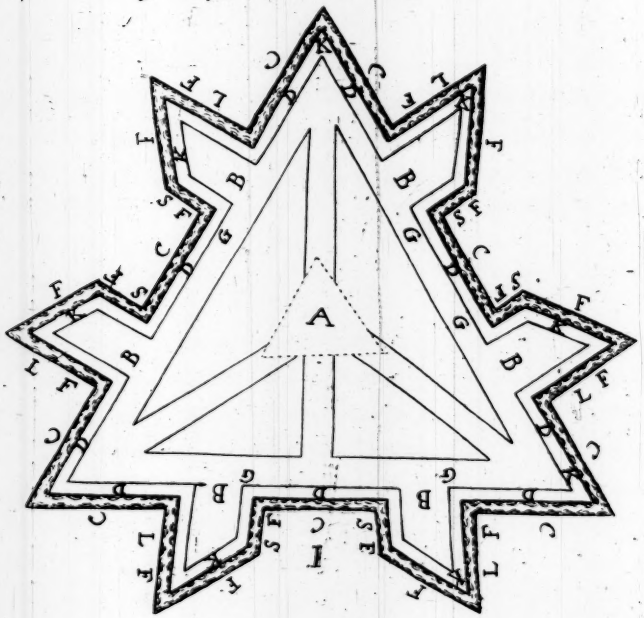
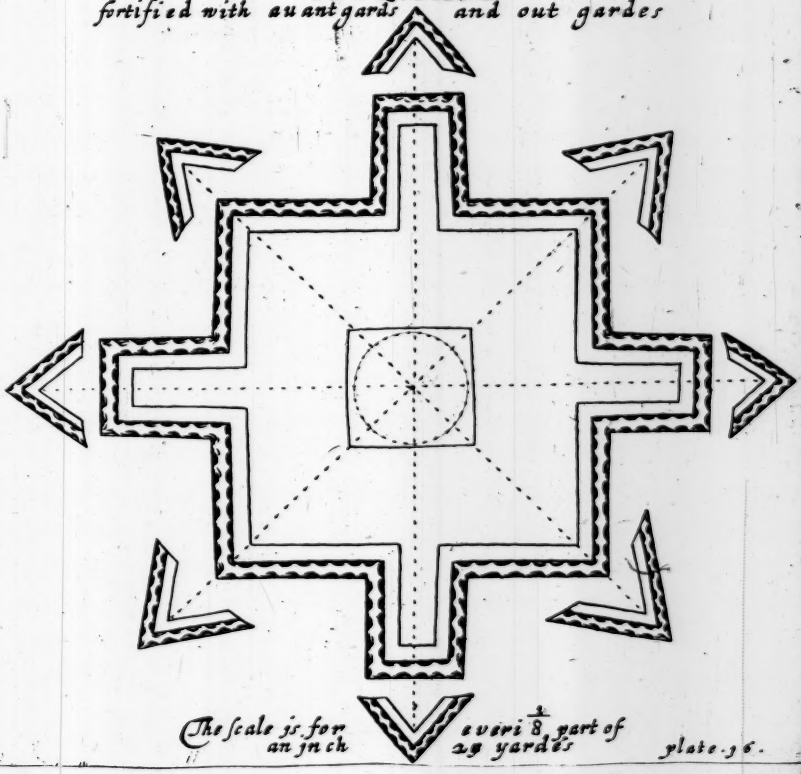


plate 95.

A SQVAIRE
fortified with auantgards and out gardes

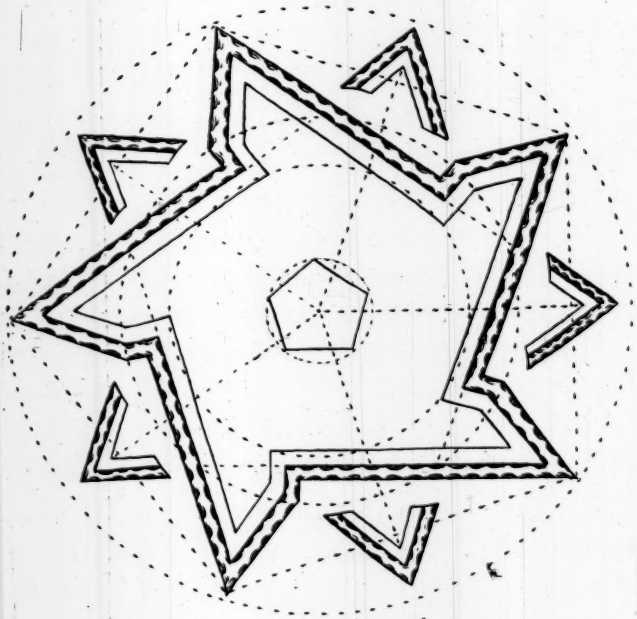


The scale is for an inch every $\frac{1}{8}$ part of 29 yardes

plate. 36.

A Pentagon

fortified with avant gardes and out gardes



The scale is for every $\frac{1}{8}$ *part of an inch : 20 : yardes*

plate. 77.

A ½ SEXAGON

fortified with auant gardes and out gardes

The scale is 90 yardes for euer⅛ part of an inch

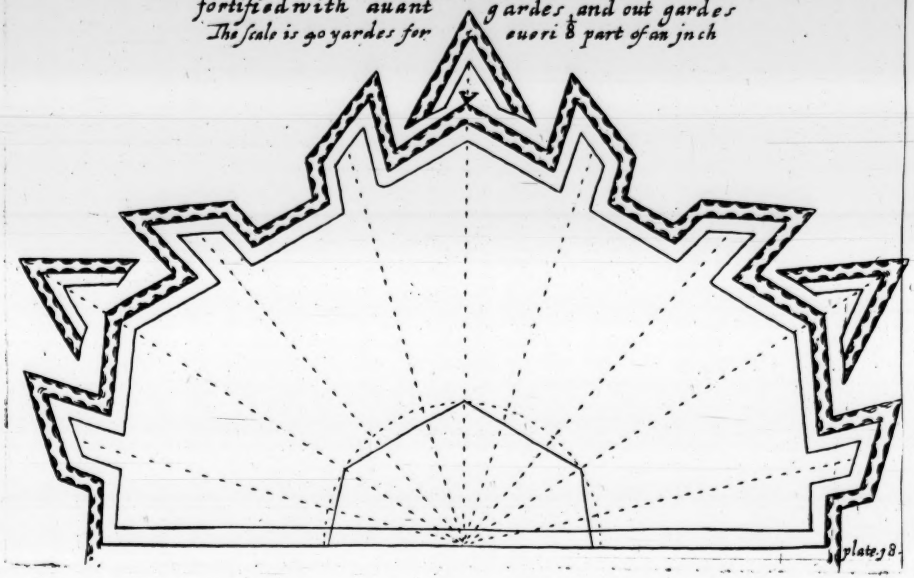
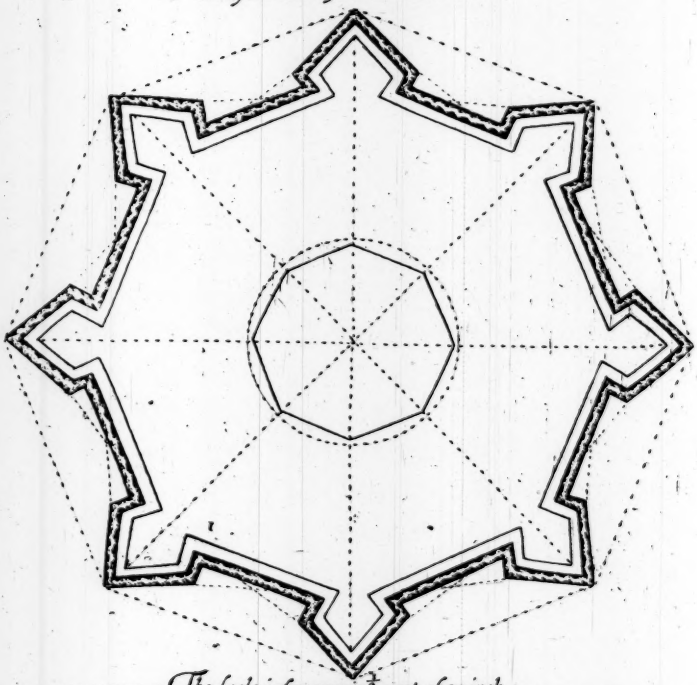


plate 38

AN OXOGON
Fortified with small Flankers



The Scale is for every ⅛ part of an inch 20. yardes

A PARALLOGRAME

fortified with: 18: small flankers; the scale is for everi: 8: part of an inch. 46. yardes and $\frac{1}{3}$

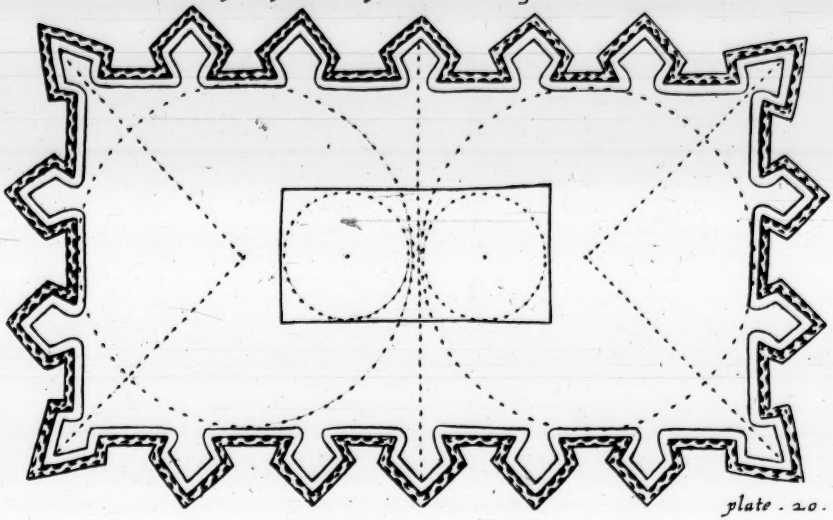


plate. 20.

A DEMY SQVAIRE

fortified with 24. small flankers, the scale is for everi 1/8 part of an inch. 25. yardes

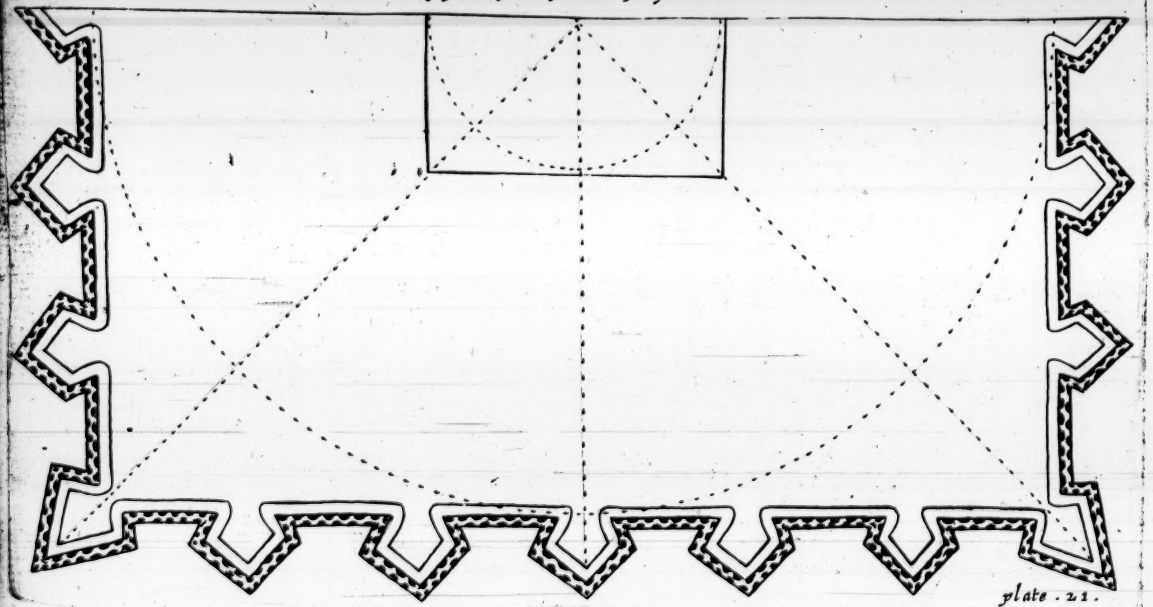


plate. 21.

ADEMY FIGVRE OF 24 ANGLES

fortified with 24 small flankers ; the scale 40 yardes for everi $\frac{1}{8}$ part of an inch

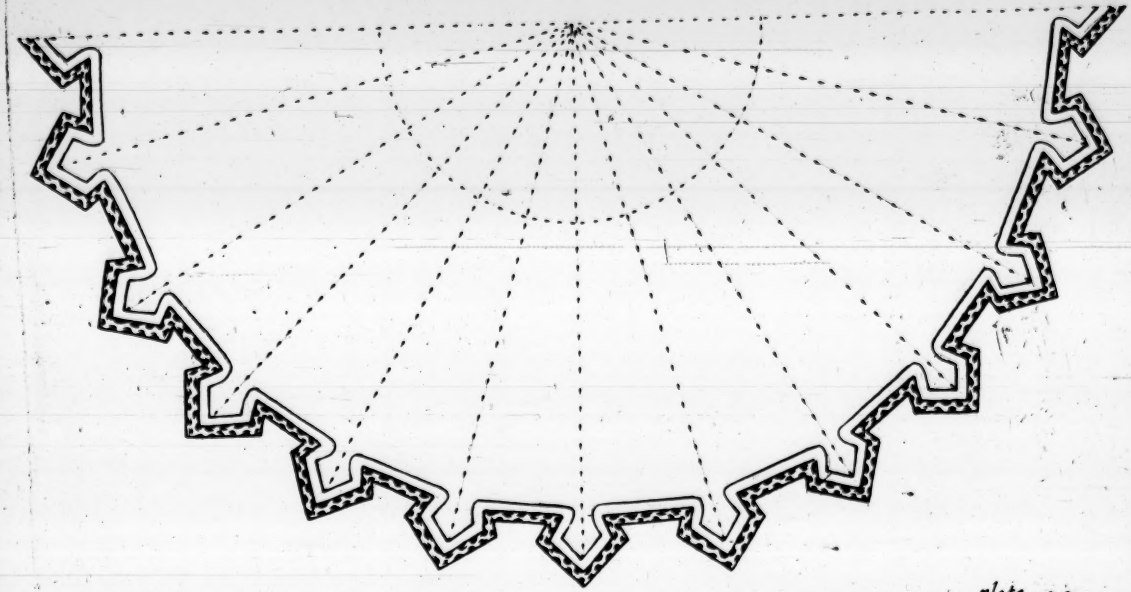
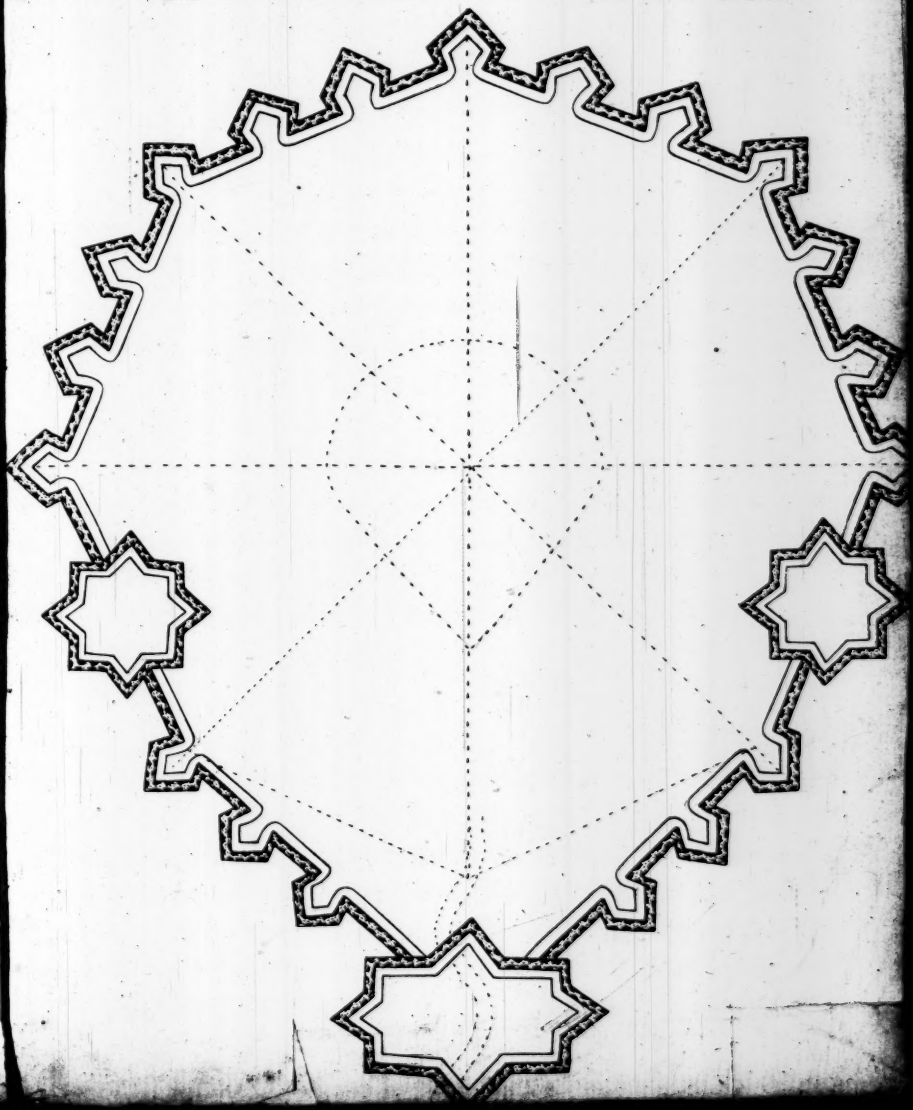


plate . 22 .

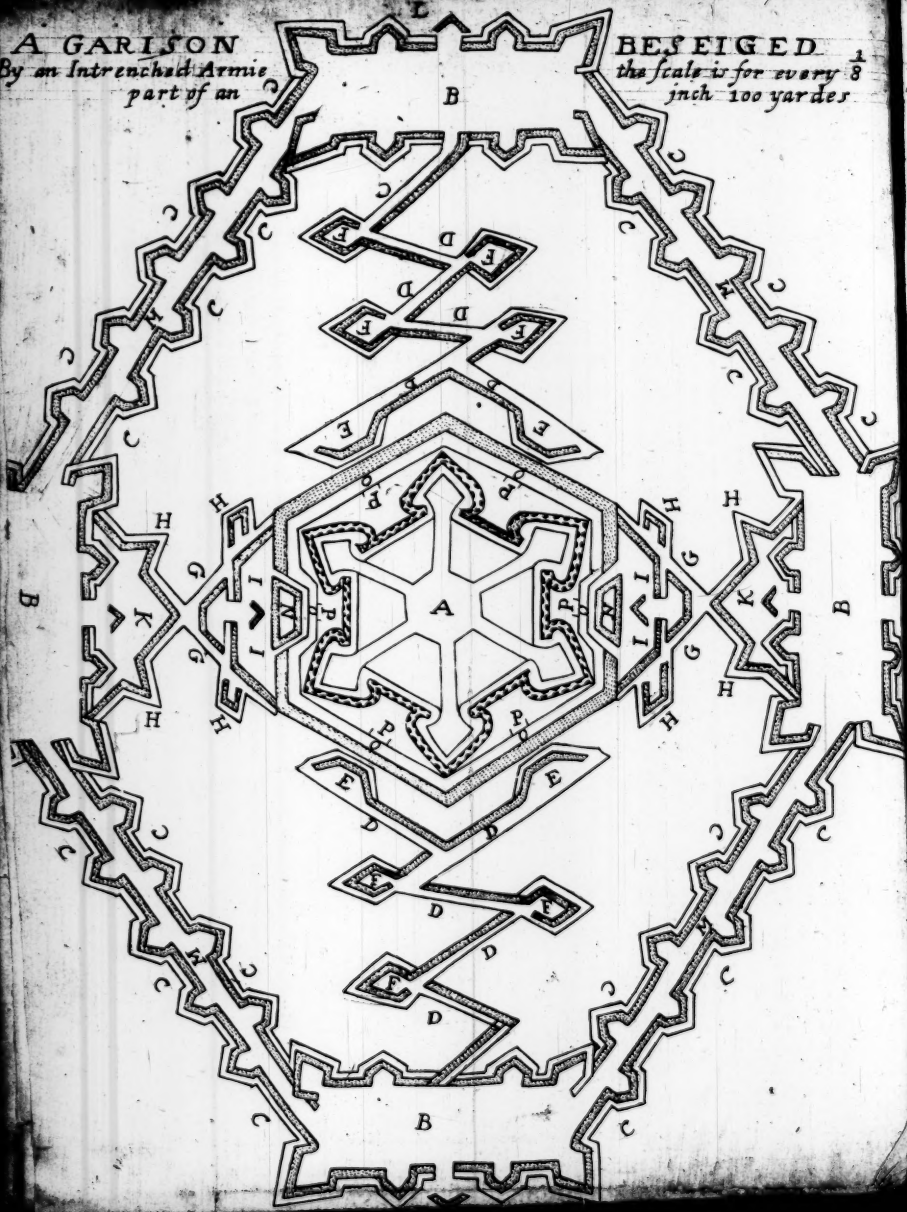
NORTHAMPTON RIGHTLY

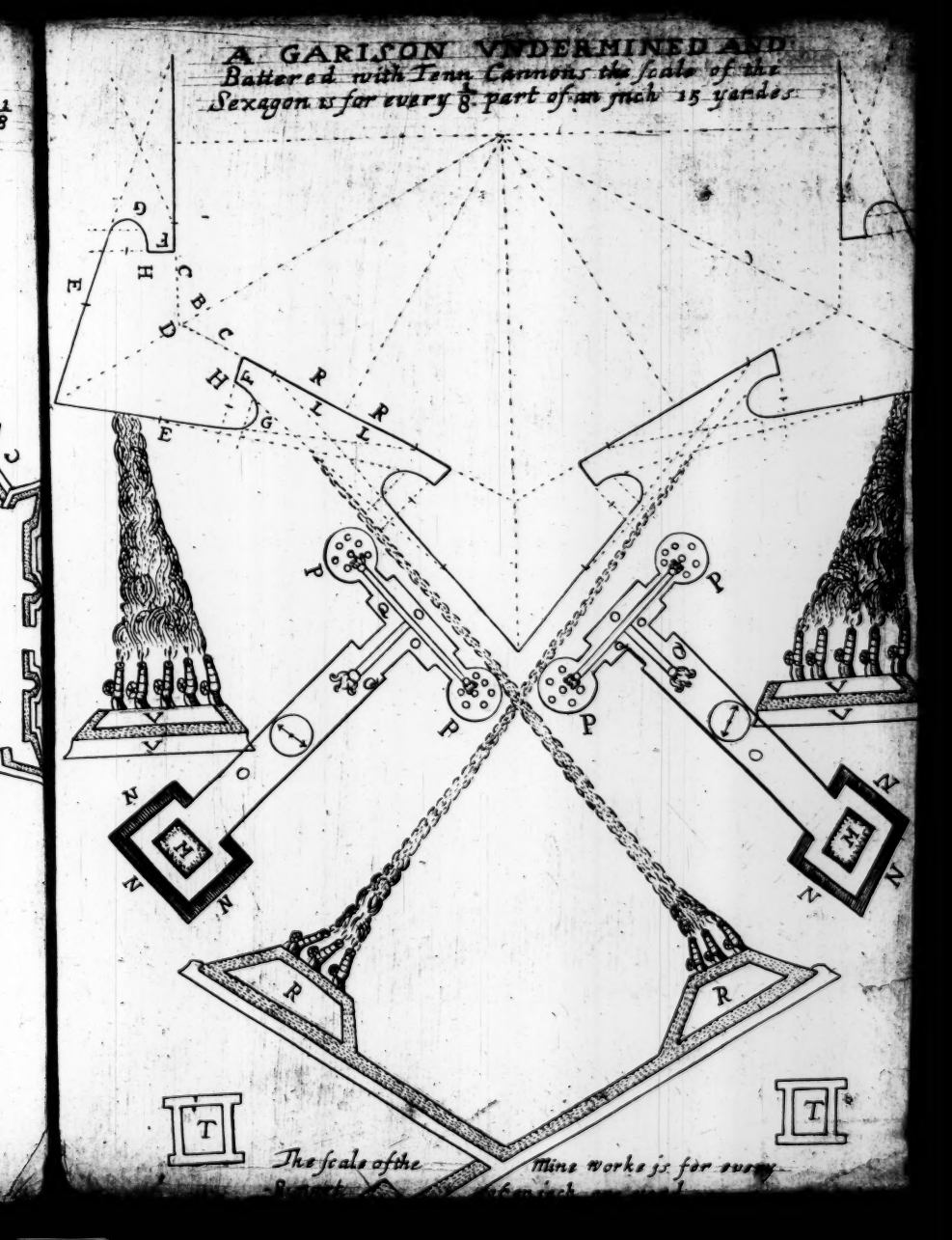
Fortified

The scale is for every ⅛ part of an inch: 50 = yardes



A GARISON BESEIGED 1/8
By an Intrenched Armie the scale is for every
part of an inch 100 yardes




A GARISON VNDERMINED AND
Battered with Tenn Cannons the scale of the
Sexagon is for every 8. part of an inch 15 yardes
The scale of the
Mine worke is for every

OF THE ART OF ASSAILING IN GENERALL.

AS there is diverſitie of * gifts in the ſpirituall Function, among thoſe that God hath ſet apart from their mothers womb, to be the Meſſengers of the bleſſed tydings of the Goſpell of Chriſt: Even ſo God out of his admirable wiſdome, doth alſo beſtow different gifts to men of one and the ſame profeſſion: But this wiſe diſpenſation of his gifts is more apparently ſéene in the varietie of parts that hee is pleaſed to beſtow upon the moſt eminent Commanders, that have anciently, and do at this day exerciſe themſelves in the Art of war: For among all the ancient and moderne Commanders, there was never any but *Cæſar*, that did attaine to the perfection of this Art; all the other having only received different gifts,

* 1 Cor. 12. 4.

to excell others in some of the most essentiall parts of it, but not in all. For some have excelled in the field, some in stratagems of war, some in the Art of assailing, and reducing of Townes, and some in the Art of preserving of them: And some have beene verie successefull in the field, and yet verie unhappie in sieges. * *Nicias* Generalissimo of the Athenians, lost his life and the reputation he had obtained in Armes, by the besieging of Syracuse. And the Emperour *Charles* the fifth was alwayes victorious in *field, and alwayes foiled in his sieges; for he lost the former reputation that he had obtained by Armes, and threescore thousand men, by the sieges of Marseilles and Mests. We read that *Alexander* *the Great, *Scipio*, and *Sylla*, were prosperous in the field; *Aratus*, *Hannibal*, and *Sertorius*, successefull in stratagems of war; * *Marcellus*, *Carbulo*, and * *Titus*, happie in their sieges, and excelling in the Art of assailing, and of reducing of strong holds. And among our moderne Commanders, *Henry* the fourth King of France, and the last King of Sweden, were alwayes victorious in the field; *Scanderbeg*, * *Mont Luc*, and *Mondragon*, prosperous in their stratagems; the Duke * *de Parma*, the * Marquesse *Spinola*, the two Princes of Orange, *Maurice* and *Henry*, and the Ma shall *Gaston*, wonderfully successefull in their sieges. And in the Art of defending of Townes, *Monsieur de la Valette*, great Master of Malta, the Duke of Guise, * Sir *Francis Vere*, and of late Colonell *Massey*. But, as I have said before, there never was any perfect and successefull in all the essentiall parts of the Art of war, but *Cæsar*; for hee hath excelled all others in the field, in the Art of fortification, defending, and assailing, in his stratagems of war, in his admirable activitie, in his prudent forecast, in his intrenched * Camps, in his militarie discipline, and in taking the opportunities of war by the fore-lock, to advance his designes. And therefore the Duke *de Roan*, in his *Perfect Captaine*, doth affirme, that all the most famous exployts of all these fore-named moderne Commanders, were but weak imitations of the noble and unparalleld actions that he did execute and perform at the siege of Alexie in France, as the master-peece of this admirable Souldier.

* See Plutarch in his life.

* See Sleidans Historie.

* See Plutarch in their lives.
* See Tacitus.
* See Iosephus
* See the French Historie.
* See the Svveden Souldier.
* See his Commentarie.
* See the Turkish Historie.
* See Demetrius Historie of the Netherlands.
* See the French Historie.
* See the siege of Malta.
* See the French Historie.
* See the siege of Ostend.
* See his Commentarie.

Now if any should presume to inquire the reasons why God was pleased to be larger in dispensation of his gifts to *Cæsar*, then

to

to any of the greateſt Chriſtian Commanders, hee being but a Heathen.

I anſwer; That it was his free will and pleaſure, and that it is not for us to dive into his private and unrevealed will; yet wee may ſuppoſe in all humilitie, that it was his pleaſure to inrich *Cæſar* with theſe unparalleld parts of the Art of war, to make him the inſtrument of the greateſt revolution that ever happened in the world; for the three former revolutions of the three Monarchies of the Caldeans, Perſians, and the Greeks, were nothing in compariſon of this laſt revolution, that *Cæſar* was the maine inſtrument of, to reduce the greateſt and moſt powerfull Common-weale that ever was, under the abſolute command of one man: And by this meanes to accompliſh the Prophecies of the Prophet *Daniel*, that propheſied many hundred yeares before, that the Roman Monarchy ſhould excell the other in might and power. We may conjecture that he was pleaſed to have the inſtrument of ſo great a work to excell all others in the Art of war, as this laſt revolution did excell the former. And wee may alſo collect by the Commentaries of *Cæſar*, that the finger of the admirable Providence of God had the ruling of all his actions; for it is beyond humane reaſon or beleefe, that fiftie thouſand men ſhould pen up foureſcore thouſand in Alexie, and rout and defeat one hundred and foureſcore thouſand more that came to their releefe: Or overcome with a handfull of men (as he did) the great Kingdome of Ægypt, and defeat ſo many great Commanders joyned together in Africa and Spaine. See Daniel chap. 7. ver. 17

To conclude the point, God under *Cæſar* was the Author of all theſe great actions, and ſo hee is of all our moderne Commanders exploits, yet wiſdome, valour, activitie, and experience in Armes, are the ſecondarie cauſes of their great atchievements; and theſe rare qualities are as much required to be in a Commander in chiefe, that will excell others in this Art of Aſſailing, that we are to ſpeak of, as in any other eſſentiall part of the Art of war.

Now ſince the erecting of ſtrong and well-lined works are but a part of the Art of defence, that will availe little, except the Governour of a Garriſon thus fortified be provident, valiant, and experienced in the practicall Art of war, to make the better uſe

of theſe works; I will in the next Chapter ſet out the charge of a prudent Governour, before I come to the particulars of the Art of Aſſailing: Becauſe this Art, and the Art of Defence, are like two inſeparable twins, that are to go hand in hand together; for it is impoſſible to aſſaile judiciouſly, except the Aſſailant be experienced in the Art of Defence; or for a Defendent to defend a place as hee ought, except hee be verſed in the myſteries of the Art of Aſſailing, to prevent in either of them, what may bee done by the Aſſailants or Defendents.

Chap. XXXII.

Of the charge and qualities of a prudent and experienced Governour.

Of the parts of a Governour.

1 HE is to be well-affected to the party he ſtands for, his owne intereſt rather inducing him to it, then otherwiſe, and faithfull and diligent in his place, for upon his fidelity, valour, and experience in Armes, depends the ſafety of a County; nay, ſometimes the welfare of a Kingdome, for the loſſe of a well-ſeated Garriſon indangers a State, more then the loſſe of an Army, and therefore it behoveth a Prince or a State to be verie circumſpect in the choice of a Governour, if the place aſſigned to him, be a frontier Garriſon, it matters not if he be of great deſcent, and allied with great families, for when they are ſuch, upon the leaſt diſcontent, they are apt to foment civill diſcords; neither is he to be of a low deſcent, but a Gentleman by birth, and by merit, whoſe valour and fidelity makes him to deſerve ſuch a place: he is to be of competent meanes, borne in the ſame County, and allied to men of repute, and abilities, and trained from his youth in Armes, and ſuch a man is reputed amongſt States-men the fitteſt for ſuch a place.

Of the choice of a Governour.

Of his manners and diſpoſition.

2 He is to be of an approved converſation, honourably inclined, no ſwaggerer, nor a vanting rover, but temperate in all his actions, not over young to be ſeduced or miſled, nor over old to avoid heavineſſe, feare, and apprehenſions, infirmities, incident to old

old men, but in the flower of his age from forty to threescore, that he may be active, provident, and vigilant, and well acquainted with all things that appertaine to his charge.

3 He is to be well versed in Histories, and to be adorned besides his naturall parts, with divers acquired vertues and qualities, but above all, he is to have a practicall knowledge, of all the essentiall parts of the Art of Warre, that he may know how to assaile and to defend places, how to Martiall his men both horse, and foot, how to advance and how to retreat, for if he hath not been present in great battells, in famous sieges, in routs, in great batteries, in stormes, and assaults, he will be terrified or astonished, upon any unexpected accident.

4 He is to be free from avarice, oppression, drunkennesse, licentiousnesse, and from all impiety, and adorned with the opposite vertues to these vices, sincere in Religion, and rather fervent then of the Laodicean temper; temperate and moderate, frugall and yet charitable, punctuall in his promises, cherishing valour, and punishing cowardice, a loving father to his souldiers, relieving them in their need, rather then to detaine or deprive them of their pay, by wiles or collusions.

He is to be free from vices and adorned with vertue.

5 He is to be acquainted with the ancient and the moderne Military Laws, and with the Civill and Politike Statutes, and Ordinances, to decide all controversies, that may happen between the souldiers of his Garrisons, and the Countrey-people, or the Inhabitants of it, he is also to love as his owne life, the place where he hath been assigned, and to procure the good and the welfare of the Inhabitants, and of all honest and religious people that sojourne there; and to have especiall care of the preservation of it, having alwaies in mind, that his life, honour and reputation, depends upon the safety of it.

He is to be learned, and versed in the Militarie and Politique Lavves.

6 He is to provide his Garrison of all necessaries for a siege, and to repaire the Workes of it in due and in convenient time, not delaying from day to day, but pressing the effecting of it, to the utmost of his power; although there be no likelihood of a siege, for when an enemy is at hand, it is too late to go about such imployments, neither is it a sufficient excuse for a Governour to say who would have thought the enemy had a design upon this place?

He is to be provident in the repaire of the vvorks of his garrison.

7 He

7 He is to be acquainted with all the principles of the Mathematiques, and especially with the essentiall parts of the Art of Fortification, that he may be able to controle the ignorance of selfe-conceited men, that take upon them to set out ridiculous and destructive workes, improper for the defence of the place where they live, with whom he is by no meanes to combine, as some do for private or politike respects, because such deformed and ill flanked Works indanger his owne life, and will one time or other blemish his honour, and reputation; and therfore he is to be skillfull in the Art of Fortification and assayling. For if the towne be lost by these defects, the blame will onely be laid upon him, and not upon the contrivers of these works: now because the safety of the Towne is intrusted to his care, hee ought not to indure that ignorant Shop-keepers bee chosen Sub-Committees of the Workes of a Garrison, for these places belong more properly to the wise, and prudent Gentlemen of the County, and to the most experienced Officers of the Garrison, then to such men as these that will precipitate their owne ruine, rather then they will be crost in their destructive waies.

He is to be skilfull in the Art of fortification and assailing.

8 He is to dispose of all the Functions of Warre, and to command absolutely over Horse and Foot, or otherwise, he is but a titularie Governour, and it is no wonder if divers of our Counties are plundered daily, by the incursions of the Enemies Garrisons, since he that should send out parties to curb and restraine these disorders, hath his hands tied. In all things, without order, nothing can be successefull: for a Governour to anticipate upon the prerogative of Committees, and be medling in civill and politike affaires, it is to go against order; or for Committees to anticipate and be medling with those things that belong properly to a Governours place, as to command over a Colonell of Horse, and to send out parties at randome; it is against order, and against the rules of war; for Committees should not be answerable for the defects, errours, and omissions of martiall designes; nor the Governour be answerable for any dismeanour committed, or dutie omitted, in civill or politike affaires; but everie one should be answerable for such things that belong to their places. Therefore if a Countie bee daily molested by the incursions of the Enemies Garrisons, the Governour should be answerable

He is to dispose of all the functions of vvar, and not to meddle vvith politike affaires.

Committees are not to meddle in vvarlike affaires, onely in civill and politique affaires.

anſwerable to the State for his neglect and careleſneſſe in this caſe, becauſe the protection and preſervation of the whole Countie depends upon his charge. On the other ſide, if the men of war of ſuch a Countie be not duly paid, and notwithſtanding the Countie is oppreſſed, the Committees are anſwerable to the State for this omiſſion and diſmeniour. But by the common diſorder there is in the greater part of our Counties, betweene the Committees and the Governours of the head Garriſons, by the anticipation they do upon one anothers charges, the State knowes not whom to call to accompt for divers groſſe abuſes that are daily committed, under which divers Counties groane, and become deſolate. In a word, there is no wiſdome nor policie to ſuffer the Committee to manage, or to diſpoſe of the deſignes of war; or to ſuffer the Governours to raiſe contributions for their owne Garriſons pay, or to meddle in any manner of way in civill or politike affaires, except it be to decide ſome differences that may befall between ſome Souldiers, and ſome of the Inhabitants.

9 He is to obſerve an auſtere militarie diſcipline, and to ſuffer none of the Inhabitants to be wronged and abuſed by any of the Souldiers of the Garriſon; for if hee give them an inch this way, they will take a foot; and of the two, hee is rather to take the part of the Inhabitants then of the Souldiers, becauſe the Souldiers are moſt commonly the firſt Aggreſſours: Yet for feare this rule ſhould not be generall, hee is to examine the caſe, and to diſtribute juſtice impartially. Hee is alſo to traine his Souldiers everie week, and withall to command the Sargeant of everie Company to inſtruct them daily, when their Company enters in guard, and eſpecially the youngeſt and raweſt Souldiers, how they ſhould manage their muskets and pikes, that they may be the more perfect when they traine before him, in the handling of their Armes. And for the Horſe, when they are at home, once a fortnight he is to appoint their Colonel a place in the field near the walls, where he is to be himſelfe, to ſee them exerciſe, by dividing their Regiment in two equal parts; the Colonel commanding one partie, and the Lievtenant-Colonell the other; the one being the Aſſailants, and the other the Defendents. And in all theſe exerciſes the Governour is to take exact notice both of the Horſe and Foot,

He is to be auſtere in the Militarie Diſcipline, and juſt in his judgment.

He is to be carefull and preſent at all militarie exerciſes.

Foot, that are defective in their horſes, armes, and apparell, and to cenſure them ſeverely for the firſt time, and to puniſh them the next training day if theſe defects be not amended.

Of the number of the Courts of Guard.

10 He is to be active and vigilant, that Centinells be placed and relieved punctually at their hours, and to over-ſee the Courts of Guards everie night, not relying altogether upon his Major, for two eye-witneſſes are better then one; the French, whoſe Garriſons are not ordinarily above one Engliſh mile, and halfe circumference, content themſelves with ſix Courts of Guards, the greateſt in the Market-place of 120. men, foure more at the foure gates of 60. men a piece, and one before the Governours lodging of twenty men, and by this calculation there is to be in that Garriſon 1140. Foot-ſouldiers, of which 380. are to enter into guard every night, that they might have two dayes reſpit in three. Their Centinells or Centries are relieved in the night time everie houre, and in the day time every two houres, and they place at everie 200. yards diſtance a Centry, if their Garriſons be fortified by Baſtions, they place beſides the above-ſaid Centries, three upon everie Baſtion, one at the point of it, and two at the two ends of the faces, next to the flanks, ſo that this place of ſo ſmal a Circumference is to have forty Centries relieved every hour in the night times, beſides them that are to make the Rounds, that are to be done three times everie night, beſides a private Round called by the French *La Patronille*, every Round is to have a principall * Officer, their number is commonly of 12. and this private Round of as many, it marcheth commonly in the dead time of the night, that is an houre before day, the moſt dangerous time for ſurprizes. By this calculation the Reader may ſee that the greater part of our Garriſons are not halfe manned as they ſhould be; for I know ſome of three Engliſh miles and halfe circumference, that have not a thouſand Foot-ſouldiers, and a place of this extent ſhould have at leaſt ten or twelve Courts of Guards, whether it hath ſo many gates or no; for where the diſtance between two gates are over great, there is a Court of Guard to be erected in the midſt, to prevent a ſurprize by ſcaling.

Of the number of Sentinells.

* The Governour is ſometimes to go the Rounds, but the day & houre of his going is to be kept private.

Of the Rounds, and of the French Patronille.

11 He is to have care to ſee his Garriſon provided with Ordnance, Armes, Balls, Ammunition, Fire-works, ſome ready

dy made, and ſtore of materials ready to make more, and with all manner of Engins of war, as Mantlelets and Ladders, Tortoiſes, Pioniers tooles, ſtore of timber, of wooll-packs, pitch, oyle, Brimſtone, coale for powder, pit-coale, and wood for fewell; and hay, ſtraw, oats, and peaſe for the Horſe. Of the Ordnance and Ammunition of a Garriſon.

If I ſhould here relate the number and quantitie of theſe neceſſaries, that the Italians, French, and Hollanders uſe to provide their Garriſons withall, it would ſeeme to many a falſe, or an incredible relation; and therefore I will paſſe them over, and will only ſpeak of a verie meane proportion, fitted according to our abilitie, after I have given you a hint of the ſtore of the Citadell of Milan. The Citadell of Milan is a perfect Sexagon, fortified by ſix Baſtions with Orillons, as in Plate 12. The Circumference of it cannot be at the moſt above an Engliſh mile and a quarter, and yet it had in my time 160 Cannons and Demi-Cannons in the Magazines, beſides thoſe that were placed in the points, faces, and Flanks of the Baſtions, that were above 90 in number, and in all 250 at the leaſt, and fiftie thouſand iron bullets of all ſorts, and two hundred thouſand weight of powder, and victualled for a yeare for three thouſand men, and with Armes and other neceſſaries proportionable, and ſuch proviſions will ſeeme (as I have ſaid) incredible.

But the meaneſt proportion allowed for forraine Garriſons is of fiftie Peeces of Ordnance, for a Towne of two Engliſh miles circumference, of theſe ſorts, ſix Cannons, ſix Demi-Cannons, ſix long * Culverins, twentie Sacres, and twelve Drakes, and one hundred thouſand weight of powder, that is a thouſand barrells of powder. But it were well if one of our Garriſons of three or foure miles circumference were thus provided: for Armes there are to be of all ſorts as many in the Magazines, as there is Souldiers in the Garriſon; and for balls, the leaſt number that can be provided, is for Cannon-balls, Demi-Cannons, and long Culverins, ſix hundred a peece, that is 1800 of theſe three ſorts, and 2000 balls for the Sacres, and 1200 for the Drakes, and fiftie new Carriages of all ſorts in the Magazine, that if any Peece of Ordnance be diſmounted, it may preſently be ſet up againe; and twentie five thouſand weight of match, five hundred Granado's, and 100 great ones for Mortar-peeces, and as many

* If it be a Sea-towne you are to double the number of the long Culverins, and to deſalk the ſame from the Sacres.

materialls to make twice as many more, and of all other neceſſaries ſpoken of before proportionably.

12 He is to have a provident fore-caſt to provide in due ſeaſon his Garriſon with all manner of victualls, and malt, for otherwiſe the ſtrong Workes of the Garriſon, the number nor the valour of the Souldiers, nor this ſtore of Cannons, Ammunition, and Armes, Granadoes, and other neceſſaries will availe nothing, if the Garriſon be diſtreſſed for want of victualls, for all theſe things will but inrich the Enemy, when by famine the Towne ſhall bee inforced to yeeld to the Enemies mercy.

He is to provide his Garriſon vvith all manner of proviſions and victuals.

The two moſt neceſſarie proviſions, are bread and beere, and therefore the Governour is to take an exact accompt of the number of men, women and children, there is in his Garriſon, I meane with the Foot and Horſe-men of the Garriſon, that I will ſuppoſe to be ten thouſand living ſoules. The leaſt allowance of bread and beere that can be given, is of a pound of bread and a pottle of beere a day, now everie ſtrike, or buſhell of Corn, will yeeld, 56. pound weight of bread, and this will amount to 188 ſtrike a day, and in three months to 16920. ſtrike of wheat, that is 2115. quarters of wheat. And as for beere, everie barrell of beere containes 36. gallons, and every quarter of malt will make eight barrells of ſmall beere, that containes 576 pottles of beer; ſo that after this rate there will be ſpent 17. quarters and halfe of malt in a day, but we will allow 18 quarters for the ſouldiers mornings-draught, that will amount in three moneths to 1620. quarters of malt.

The ſalt is the next, for without ſalt a Garriſon cannot ſubſiſt, and therefore one hundred quarters of ſalt is the leaſt that can be provided for three months. Butter and Cheeſe are the next, and ten thouſand weight of each is of the leaſt, and a thouſand barrells of Porke, and of ſalt Beefe, is little enough, beſides a thouſand fliches of Bacon, five hundred quarters of white Peaſe, two thouſand weight of Rice, twenty tun of Vinegar, for it is uſefull to coole the pieces of Ordnance when they are over-heated; three or foure tun of oyle, great ſtore of timber and fewell, and eſpecially of bruſh bavins, for to repaire breaches, good ſtore of ſugar, and ſpices, but ſpecially all manner of Phyſicall drugs, for ſick and wounded men, and ſtore of Chyrurgions to dreſſe the

the wounded ſouldiers: All theſe things and manie more, a provident Governour will have a care to provide his Garriſon withall, if he intend to make a noble reſiſtance, and to preſerve his Garrriſon, life, honour, and reputation. But divers will object, that the providing of theſe things belongeth to the Committees, and not to the Governours. I anſwer, that it belongeth to the Governours in forraine parts, and that he is bound by his place, after he hath twice or thrice admoniſhed them, to provide theſe things, and they do it not, to proteſt againſt them, and to acquaint the State of their neglect, and omiſſion of it, otherwiſe if the Town be loſt by the want of anie of theſe things, the blame will be imputed onely to the improvidency of the Governour. Moreover *he is to be verie vigilant, to prevent ſurpriſes, by Ambuſhes, that may lye undiſcovered in allowes neare to a gate, that may of a ſudden ſlay the Centeries, force a Court of Guard, and take a towne; or by ſcaling in the night time, for it is a thing eaſie to be done, to ſcale Workes that are ſo low as ours. To prevent theſe ſurpriſes, and ſcaling, the Governour is to ſend out every night 24. horſe divided into foure parties of ſix a piece, and theſe parties muſt range all the prineipall rodes that lead to his Garriſon, for the diſtance of ſeaven or eight mile everie way, as South, North, Eaſt and Weſt, and to cauſe at the break of day all hollowes, and old walls about the towne to be viewed by two ſouldiers of everie gate, that are to be put forth at the Sally-ports, and to come in againe before the gates be open, and their draw-bridge put down, and by theſe two meanes the Governour will preſerve his Garriſon from ſcaling and ſurpriſes.

* The dutie of a Governour to prevent ſurpriſes and ſcaling.

Chap. XXXIII.

Of ſix different wayes, how ſtrong Holds may be reduced.

Antigonus King of Macedonia was wont to ſay, that the ſtrongeſt Hold in the world might be reduced, if by the gate of it a Mule laden with gold might enter therein, meaning that

ſtrong Holds that were by nature or by art impregnable, might be won by the infidelity of the Governour, if he was inclined to Avarice, and greedy of money, whereby we may collect that concuſſion and briberie was as familliar in thoſe daies as they are in ours: And this is one of the firſt meanes that *Philip* the ſecond King of Spaine did attempt to reduce the ſtrongeſt Garriſons of his Enemies, for by theſe meanes he obtained Cambray and Callis, in the reigne of *Henry* the fourth King of France; a good Caution for a Prince or State, to make choice of truſty and faithfull Governours, that may be free of Avarice and Concuſſion.

The firſt vvay attempted by the Spaniard is briberie.

The ſecond vvaie is ſtratagems of vvar. * See the Hiſtorie of the civill vvars of France.

The ſecond way is more noble and generous, and that is by Stratagems of War, as the great City of * Amiens was taken by *Montdragon*, by four and twenty ſouldiers, hidden under foure waggons laden with hay, and a diſguiſed ſouldier that was upon the laſt load, that tumbled downe wittingly a basket of apples, and wall-nuts, when he ſaw the waggon under the Portcullice, whereupon the Centries and all the ſouldiers of the Court of Guard being over eager about the taking of them up, were all ſlaine by the 24. armed ſouldiers, that came out of the waggons, and the gate made good, till a thouſand horſe-men with as many Dragoones behind them, entred the towne and took it without little or no oppoſition at all; or as * Breda was taken by a French Captain, with twenty ſouldiers hidden in a ſhip laden with turffe, that was let in at the Port, and in the night time ſallied out, killed the Round, and put to the ſword all the Souldiers of the Court of Guard that were next to the gate, where a thouſand Horſe and five hundred Foot of their party lay in ambuſcado, and ſo tooke that ſtrong Hold, without much loſſe or oppoſition. But the two next Stratagems are worthy of admiration; in the civill warres * of France a young Gentleman and a Royaliſt, did oftentimes repaire to a ſtrong Garriſon of the League, to ſee a kinſman of his, that was a Commander of the Garriſon, and having noted that the ſouldiers of that Court of Guard next to the gate that he was uſed to come in, kept but an indifferent watch, perſwaded five young Gentlemen of his acquaintance, that had no more haire on their faces then he had himſelfe, to attempt the taking of that Garriſon, they imbraced

* See the Hiſtorie of the Netherlands.

the

the motion and diſguiſed theſelves in Gentlewomens apparell, ryding behind ſix Gentlemen, that lived neare that Garriſon; everie horſe-man having at his ſide a young valiant ſouldier, diſguiſed like Lacquie's that made up eighteen in all, having piſtolls in their pockets, and coming to the gate of the Garriſon, he that rid formoſt carried behind him the undertaker diſguiſed like a Gentlewoman, the Serjeant of the Court of Guard began to examine where they went: we come (ſaith the firſt horſe-man) to be merrie in the Towne, with theſe Gentlewomen our kinſwomen, whereupon he let them paſſe, but being come between the two gates, where the Portcullice was, the firſt Gentlewoman fained to be ready to ſwound, and called to ſome of the Court of guard for help, they as officious men came all to aſſiſt the ſicke Gentlewoman, whereupon they all lighted, and the Lacquie's did inſtantly run to the Court of guard, and brought all the Partiſans and Halberts they could lay hold on, and the Gentlemen and Gentlewomen drew out their piſtolls, and ſlew everie one of them a ſouldier of the Court of guard, and made good the gate till their Ambuſcado that was within a muſket-ſhot of the towne in a hollow came to their reliefe, and ſo took this garriſon that was ſtrong and of great concernment. The laſt Stratagem is knowne of all men, for it is the ſurpriſing of Hereford, that was as neatly carried as any of the former, for he that played the Conſtables part, was certainly a valiant Gentleman, for it was a great attempt to venture upon ſo ſtrong and ſo well manned a garriſon as that was; The third way was uſed by the Parthians to famiſh *Craſſus* * Army in Armenia the great, and by the Duke *de Montmorency*, in the daies of *Francis* the firſt King of France, to famiſh the Emperour *Charles* the fifths Army, that was coming to beſiege Marſeilles; for he perſwaded the King three weekes before the coming of the Emperours Army, to publiſh a Proclamation that all the Inhabitants of what degree ſoever, that lived within twenty miles compaſſe of the City of Marſeilles, ſhould upon paine of death, remove all their Cattell, Wine, Corne, and Movables, and bring them to his Camp where they ſhould have money for their corne and wine, and lodging for themſelves in the adjacent townes, with paſture for their cattell, at free coſt, till the warre was over: and thoſe that

The third vvay is by policie.

*See Plutarch in Craſſus life.

* See Du Belluy his Commentaries.

that did not obey this Proclamation, within fifteen daies, were inforced to obey the ſame by a partie of 2000. horſe that were ſent by the King to ſee the execution of it, whereby the Emperour was reduced within a moneth after, to ſuch extreame want of victualls, and of provender for his horſes, that he was inforced to raiſe his ſiege with the loſſe of his former reputation, and of 30000. of his men that periſhed by famine, and by the ſword upon their retreat into Italy.

This policie may be uſed alſo to reduce the ſtrongeſt Garriſon that can be, if the partie be maſter of the field, or lye in an intrenched Camp ſome twentie miles off, that hee may day and night ſcoure all the roads with ſtrong parties of Horſe, as the Duke *de Montmorency* did; for after the favour of God, it was the ſecondarie cauſe of the preſervation of the Kingdome of France: for if the French King had enforced the Emperour to a pitcht battell, and that he had been routed, the Emperours Army had advanced without oppoſition to the verie gates of Paris, becauſe there was not in thoſe dayes any ſtrong hold between Marſeilles and Paris. But by this meanes the French King did not hazard his Kingdome upon the caſuall event of a battell, and yet preſerved the ſame, and did utterly waſte and reduce to nothing, the greateſt Army that ever this Emperour was Maſter of, and that was led by the moſt experienced Commanders in Chriſtendome.

The fourth vvay is by ſcaling in the night time. * The beſt vvay for a Governour to prevent theſe ſurpriſes by ſtratagems of VVarre and ſcaling, is ſet out in Chap. 32.

The fourth way is by ſcaling in the night time, as Geneva was likely to have been taken by the Lord *D'Aulbigny*, Generall for the Duke of Savoy in *Henry* the fourths dayes; for there were above five hundred men gotten up upon the Rampiers before they were diſcovered; and had it not been by the favour of God, that one of the firſt Inhabitants that was alarmed, did run to the lower Flanks of one of their Baſtions, that had two Cannons mounted, pointed and charged with caſe and chaine-ſhot, and preſently fired them, whereby all the Aſſailants ſcaling-ladders were broken, and caſt into the dike, the Citie had been taken; but the Souldiers and the Inhabitants being aſſured by this meanes, that no greater number then was entred could annoy them, took courage, and put the greater part of them to the ſword, ſome Lords excepted, that they cauſed to be beheaded the ſame day.

And

And this is the reason that I have prefſed ſo much in my former diſcourſes of the practicall Art of Fortification, the neceſſitie there is to erect upper and lower Flanks, as the only meanes to preſerve a ſtrong hold from ſcaling in the night time, and from caſting of galleries over the mote or dike, to prevent a generall aſſault; for theſe Flanks (under God) were the cauſe, not only of the preſervation of Geneva, but of Caſal in Italy ſome certaine yeares ſince; for the French * Governour that was entruſted by the Duke of Mantua to defend that ſtrong hold againſt an Army of thirtie thouſand men, commanded by the Marquiſſe *Spinola*, did make ſuch uſe of the lower Flanks of the Baſtions of that Garriſon, that he broke three times one after another, the ſtrong galleries that the ſaid Marquiſſe did caſt over the mote, and hindred him by that meanes to come to a generall aſſault, and ſo enforced him to raiſe his ſiege, which diſgrace ſtruck ſuch a deep impreſſion in the heart of the Marquiſſe, that he died ſhortly after, more of griefe then by the violence of his diſeaſe, holding and reputing that it was a great blemiſh to his former reputation, to be beaten off by ſo young a Governour, from a ſiege, when hee had been reputed the moſt experienced Commander in Chriſtendom, in the Art of Aſſailing.

* He vvas the verie ſame that vvas Governour of the Iſle of Ree, called Monſieur de Thorax.

The fifth way is by the blocking up of a Garriſon at a certaine diſtance, by ſtrong Forts, or ſtrong houſes, ſeated and erected by, or neare the ſaid Garriſon. This way is tedious and uncertaine, becauſe ſuch ancient houſes are rarely ſeated in the moſt convenient places, or at an equall diſtance for that purpoſe, and by theſe defects, the reducing of the Garriſon is much retarded; for the beſieged receive ordinarily ſome releeſe from the adjacent villages. It were therefore ſafer for a Generall, if hee be reſolved to reduce a Garriſon this way, to erect foure new Forts, on the South, North, Eaſt, and Weſt of that Towne, upon the moſt convenient ſeats that can be found, within no longer diſtance then a mile, of all ſides from that Garriſon; and are to be ſeated where they may moſt conveniently command and block up the roads that lead to that Garriſon. The continent of theſe Forts are to containe foure hundred Foot, and two hundred Horſe, and from * Fort to Fort, a ſmall Line of Communication is to be drawne, with a dike of ſix foot deep, and nine foot broad.

* The fifth vvay is by the blocking up of a Garriſon at a certaine diſtance.

* The lodgings of theſe Forts are to be lovv and ſlight, ſo they be kept drie, for it matters not ſo they maie laſt halfe a yeare.

And

And if there be a River running thorow, or by one side of that Garrison, two woodden bridges are to be erected, either with boats, or with piles, and two good Redouts erected to defend these bridges. And all this may be done in lesse then a moaths time, by an Army that is eight thousand Foot strong, and two thousand Horse, so it be Maister of the field: And this course being taken about the latter end of October, this Garrison will be in such streights for victuals and Ammunition before March, that it will be enforced to yeeld to the mercie of the Assailants: for it cannot be releeved, but by a greater partie by halfe then are billetted in these foure Forts and two Redouts, because they releeve and joyne one with another upon all occasions.

The sixth and the surest vvay is by a double intrenched Camp.

The sixth and the most certaine and method-like way, is by an intrenched Camp used in *Cesars* dayes, and at this time in Flanders by the French and Hollanders; because if all the five former wayes having been attempted and faile, this will assuredly carrie away the Garrison, either by storme or famine. But before I come to the particulars of it, I will relate the judgements of the most experienced Commanders, both ancient and moderne, whether the sallies of the Defendents are profitable to them, or necessarie to be done, to hinder the Assailants to incamp themselves, and to make their approaches.

Chap. XXXIV.

Of the opinions of experienced Commanders, concerning sallies made by the Defendents at the beginning of a Siege.

* Whether it be best to sallie, or not to sallie, in the beginning of a Siege.

ALL our moderne Commanders do not agree in this point, for some would have no * sallies at all, till the Assailant begin to pierce the Counterscarp with their secret approaches, because they would maintaine the souldiers of the Garrison in their full number and strength, for the most urgent occasion of defence, that is, when the enemies do indevour to cast their galleries over the mote, and to make their Mines for to come to a generall assault.

assault: their reasons are these. 1. All the sallyes of a Garrison say they, cannot hinder an Assailant Army to perform eight of the ten operations, that shall be spoken of in the next Chapter. 2. If it be never so well manned, the Assailants are alwayes five to one at least, and sometime ten for one; and therefore if the Defendants in these sallyes lose one man, their losse is greater, then if the Assailants lose five; nay, more then ten, because they may be supplyed and recruted: but the Defendants cannot, but by the coming of a great Army to their releife. 3. When the Defendants sally so farre from their Rampiars, as to endeavour to impede the incamping of the Assailants, or the making of their first approaches; it is ten to one say they, if they be not beaten and driven in again with losse. * Nay, they may be utterly routed, and their retreat into the town stopped; if a good party of horse of the Assailants, can get between their Rampiars and them: which if they doe, as it hath been oftentimes effected; the strength and the courage of the Defendants is much weakned, and the town in a manner halfe reduced. Therefore say they, it is safer, and a part of greater wisdome for a Governour to keep in his men till the Assailants are near the *Contre escarpe*, that their retreat may be secured by their musquet shot, from the *Contre escarpe*, and from the Ordnance of the Bastions and rampiars. But if in case the Garrison is not strongly manned, they are not say they, to make any sallyes at all; but only to discharge now and then some Culverings shot when some of the Assailants horse are in a body, and in the reach of the shot; or to discharge a Drake or two when they see some Commander of quality come neare to view their Out-works: for such expences are not alwayes cast away, for many great Commanders have been slain after this manner; and among the rest the King of *Sweden* * escaped narrowly, for his horse was killed under him, and the hinder part carryed away by the shot of a Sacre, as he was viewing the works of the Castle of *English-State* in *Bavier*. On the other side, some other Commanders maintain,

* Forces that sally out are subject to be routed, if a party of the Assailants horse goeth between them and the town.

* See the *Sweden* souldier.

1. That if a Garrison doe keep within their Rampiars, and make no sallies at all, that the Assailants are incouraged by it; and suppose the town to be weakly manned, or ill provided of

Ammunition, if they be not lavish of their powder, in shooting dayly their Culverins, to hinder with shot the assailants approaches.

2. They say that if the Defendants doe not endeavour to impede by sallyes their approaches, before they come to pierce their *Contre escarpe*; that their sallies will be then to little purpose, because they may be so suddenly begerted, that they will not then be able to sally forth at all.

3. That to gain time, which is more precious in sieges, then to any other occasions of warre, because they hope to be relieved by some party of theirs, if they can hold out but a certaine time, that the defendants are by their dayly sallyes, to hinder the Assailants approaches; and to the utmost of their power, to impede them, to break through their *Contre escarpe*: for if they can but busie them three weeks or a months time, about these operations, it will much dishearten the common souldiers, and discourage the Commanders of the Assailants Army.

Now to decide this point I leave it to the judicious Reader, yet I will inform him that the Duke *De* * *Roan*, Sir *Anthoine* * *De Ville*, * *Petro Sardy*, and the greater part of the *Italian* and *French* Commanders, side in their judgement, with the first opinion here related; and that I conceive it also to be the safest way, and especially in this civill warre of ours; in which, our Garrisons are so ill manned, and so ill provided with Ordnance and Ammunition. And also, because we have neither Outworks, nor *Contre escarpe*, and not so much as any lower flanks to scoure our Courtines, or ditches; and therefore our works being so weak and deformed, as the greater part are, we are to keep our men fresh and in heart, for the defence of a generall assault. Besides, raw, and unexperienced souldiers, that never were in besieged Townes, are mightily astonished and amazed, at the first approach of a great Army before their Rampiars; but when they have been wonted to look the enemy in the face, their courage and resolution is increased, and dare better attempt such sallyes then they could at the first coming. And to prevent this Panique feare, * *Marius* a great Commander of the ancient Romans, being appointed by the Senate to raise an Army to hinder the *Cymbers*, a barbarous nation, that was coming into

* See his perfect Captain.

* *See his Treaty de la charge dun Gouverneur.* Of the charge of a Governour.

* See his Military Architecture.

* See *Plutarc.* in *Marius* life.

to *Italy*, to paſſe the *Alpelins* Mounts, for they were already entred in *Lombardia*; he ſeeing that the greater part of his Army did conſiſt of raw ſouldiers, he cauſed them to lye in an intrenched Camp every night, but when he came in ſight of the enemy, their multitude, their grim countenance, their high ſtature, and barbarous carriage, and apparell, did ſo affright his ſouldiers, that he could hardly make them defend the Rampiars of their Camp; whereupon he gave charge to his Officers, to make one Regiment after another, to be day and night upon the Rampiars, that they might be wonted to ſee without feare, this barbarous and grim nation; and lay purpoſely near a month, in one and the ſame intrenched Camp, ſuffering the enemies to approach ſometimes to the very brim of the ditch, till he ſaw his ſouldiers freed of this Panique feare; and till they came and intreated him to iſſue forth of their Camp, to give the enemy battell, which he granted with much adoe, reproving them for their former feare and cowardice. And by this wiſe Policy obtained a famous victory, for there remained ſlain in that battell, foureſcore thouſand in the field of the *Cymbers*, and very few of the *Romans*. But had he ſet upon them at the firſt, when his Army was amazed, he had undoubtedly been routed; and had caſt the City of *Rome* into a great danger, for they had then no other Army ready to oppoſe them.

To conclude this point, it is moſt certain that the Aſſailants in this unnaturall warre of ours, are to come to a ſtorme the very next day that their Army hath faced a Garriſon, if the works of it be not regulary, or have no lower flanks; and their breſt-work not above nine foot high, and ſix or ſeven foot thick, with a graft of ſome nine foot deep, and twenty foot broad; for if they have but courage, they will undoubtedly take the ſame. And for the Defendants, they are not to waſt their men, and Ammunition, in ridiculous ſallyes, but to bee watchfull, and valiant to oppoſe the aſſailants in a generall ſtorme: for if they can beat them off twice or thrice, they will free themſelves from their fury. But if the works of a Garriſon be regulary, and lined out according to Art, and well flanked with upper and lower flanks, having the Rampiars and Breſt-works of Cannon proof, and twenty or thirty foot high, with

a graft of twenty foot deep, and forty foot broad, beſides the ſmall ditch called *La cunette*: with a good *Contre eſcarpe*, having a breſt-work of ſix foot high, with a foot-ſtep going round about the inward work, and well manned and provided with Ordnance and Ammunition; then is the Generall or Commander in chiefe that undertakes to beſiege ſuch a Garriſon, to intrench himſelf in ſuch an intrenched Camp, that is demonſtrated in Plate 24. and by degrees to make his approaches both open and private, to break into the *Contre eſcarpe*; and to beat to duſt the defendants flanks by his batteries, that he may caſt his Galleries over the mote: and ſet his Miners at work, to blow up by Mines, the Point, or Faces of the Baſtions, to come to a generall aſſault; for otherwiſe he will but ſpin out the time, and at laſt, come off with little honour and reputation.

CHAP. XXXV.

Of the entrenched Camp demonſtrated in Plate 24.

TO beſiege ſuch a ſtrong hold to ſome purpoſe, marked in this figure by the letter *A.* that the Generall or Commander in cheife of an Army, that undertakes ſuch a ſiege, may come off with honour; he is in the firſt place to entrench himſelf in foure * large quarters, of a continent, convenient and proportionable to his Army: if it exceed not foure thouſand horſe, and twelve thouſand foot, the dimenſions of theſe foure quarters marked in this figure by the letter *B.* will as I conceive be ſufficient, if it be greater or leſſe; his Enginers are to encreaſe or to diminiſh the Continent of it. For we have found by experience, in this unnaturall civill warre of ours, that to beſiege ſtrong holds, without an intrenched Camp, * is wittingly and wilfully to ſpin out this war, becauſe it is an eaſie thing for an experienced and active Commander to beat up and put to rout a quarter of our Armies, as they lye open, and that are at ſo great a diſtance one from another, as ours commonly doe; it hath been

* The firſt operation of the ten that are to be done in a ſiege.

* One of the cauſes of the ſpining out of this unnaturall warre.

been the overthrow of divers of our forces before Newark, Pomphret, Dennington, Banbury, and Dudley Caſtle; and the tedious ſpinning out of the reducing of Baſing, and Latham houſe. Beſides, they exhauſt the meanes of the Kingdome; for a Garriſon begerted with a circulary intrenchment, will be ſooner reduced in a month, then another will be in ſix that is beſieged; as we have done hitherto. For inſtance, How had it been poſſible for * *Cæſar* to have penned in fourſcore thouſand fighting men in the great city of *Alexie*, and to defeat an Army of one hundred and foureſcore thouſand more that came to their releife, with his ſmall Army of fifty thouſand men at the moſt, if he had not doubly entrenched himſelfe againſt the town, and againſt the great Army that came to raiſe the ſiege? And yet ſome will maintain that we excell in theſe dayes, the ancient *Romans* in the Art of warre; But it is not ſo, for the *French*, or *Gaules*, were then a Warlike Nation, and their Generall *Vercingentorix* was a very reſolved and valiant Commander, but it was by the Art of Fortification, and the excellent military diſcipline of the *Roman* ſouldiers, with the great activity, and the experience in Armes of * *Cæſar*, that brought to paſſe in ſo ſhort a time, ſuch incredible things; for he incloſed *Alexie*, with a double entrenched Camp, with a ditch of twenty foot broad, and twenty foot deep, without a ſlope; and erected a Rampiar of twelve foot high, and twenty foot thick, beſide a breſt-work having at every foureſcore paces a diſtance: high wooden Towers to ſecure his Archers, and to diſcharge his Baliſters againſt the Aſſailants, and the exterior of theſe entrenchments, was at the leaſt twelve Engliſh miles compaſſe, and the inward entrenchment could not be leſſe then eight Engliſh miles circumference, as may be ſuppoſed by the Continent of the city of *Alexie*, ſince it was able to billet foureſcore thouſand fighting men, beſides her own inhabitants. And all theſe works were erected and perfected in leſſe then a month; for he was not in all ſix weeks before it, ſo that it may be ſuppoſed, that the interior intrenchment, or the circulary line that did begert the city round, was done in eight or ten dayes; and ſo ſufficiently made, and ſo vigilantly guarded, that the beſieged could never break through theſe works, to joyn with them that came to their releife:

* See *Cæſars* Commentaries of the warres of *Gaul*, *lib.* 7.

* *Cæſars* works and Carriage before *Alexie* in *Erance*.

You may ſee how much it availeth, to be in a double intrenched camp.

leise: Nor that great Army could not also goe over these works, but tired themselves in endeavouring to break through. And being thus over-tired, *Cæsar* made a sally with his fresh Army, and by these means routed them, and obtained the city, that yeelded to his mercy, being not able to hold out for want of victuals. By this unparalleld example it is apparent, that there is no way to this to reduce a strong hold, and to be able to oppose a potent Army that cometh purposely to relieve it, when it is besieged.

But to return where I left, these foure quarters being set out and finished, and the Huts or Tents being set up, and the horse and foot with the Carriages, and the Train of Artillery being placed, and the Generalls Tents being erected in the midst of one of the best seated quarters, a double line * of Communication marked *C.* is to be lined and taken in hand; having in every side smal flankers as it is demonstrated, to secure the covered way, made between the two Rampiars, markt by the letter *M.* whereby one quarter may releive the other as occasion requires, without danger. Now if a deep and unfordable river run in the midst, or on the side of this Garrison, two bridges (*a*) are to be erected over the same, in the two broad sides quarters of this entrenched Camp; for in that place they will be secured without any other works, and seated conveniently to releive from both sides the river, any of the quarters, if any of thē were assailed by the besieged, or any partie that should come to their reliefe. These bridges * are to be made with Barges, or great flat bottome boats, well linked together with iron chains, and fastned to pilles droven in the midst, and on both sides of the river, that the stream may not drive them down; and these Barges or Boates, are to be covered with planks of three inches thick, and then with gravell; that Carriages and the Traine of Artillery, may passe over without fear. But if such flat Boats, nor Barges cannot be found, then they are to be erected with Pilles, and covered over with such thick planks, or gravell. Or if seasoned Pilles could not also be had, then long timber trees are to be felled, and the bark and branches being hewed away and squared, they are to be bound fast together as flotts of timber that are driven down a shallow river, where Barges cannot goe

* The second operation.

(*a*) The third operation.

* Four kind of bridges, and how they are to be erected: the first sort being the best, and sooneſt erected

goe for want of water; and five or ſix of theſe flotts well bound together, will make a ſtrong bridge, ſo it be covered with the aforeſaid planks and gravell, and faſtned in the midſt and in the ſides to Pilles, driven with violence into the ground. Another kind of bridge may be made ſuddenly, with two double rowes of empty Sack-pipes, Hogs-heads, or Beer-barrels, well hooped, and cloſe botomed, bound together and faſtned to Pilles driven in the midſt, and in the ſides of the river. As *Charles* the laſt Duke of *Burgundi*, did erect one (over the river, the Seine that runneth through the midſt of *Paris*) ſome three miles from the city, and this bridge was erected in one night: And all the Dukes Army, with his Train of Artillery, bagge and baggage, paſſed the river before eight of the clock in the morning; upon which unexpected tidings, *Lewis* the eleventh, the great Politician, was greatly amazed. See *Philip* the Commin. Commentaries.

This double line of communication, and theſe bridges being finiſhed, the Enginiers are to line out their approaches (*b*) after any of theſe two wayes demonſtrated in this Plate by the letter *D*. erecting at every return an Angle flanker, where Muſquettiers are placed to ſecure the approaches, having a Court of Guard in every one of them, of forty or fifty men; theſe flankers ſerve alſo for Carriages or horſe-men to retreat, when other Carriages or horſe-men are diſcovered coming in the next approaches, if in caſe the Generall will have them ſo narrow, that two Carriages cannot paſſe cloſe together, for he hath the diſpoſing of it: ſome therefore will have them but 12 foot broad, and 4 foot deep, and ſome twenty foot broad, and five foot deep; but very flat in the bottome: the ſlope of the ſides is not to be above a foot. The principall care of the Enginier that lines them out, is to ſet out their Angles ſo farre into the field on the right, and on the left hand, that they may not be as the *French* term it (*Enfillees*) that is, that any Cannon or Culvering ſhot, placed upon the the Angle or Point of any of the Baſtions of the Garriſon beſieged, may not upon a ſtrait line beat in any of the approaches; for if they may, the approaches are not ſafe, nor lined out as they ſhould be, but will be deſtructive to the Aſſailants; for ſuch a ſhot may indanger the lives of twenty horſe-men, or foot-men, at a time. (*b*) The fourth operation.

* Of the true ſetting out of approaches.

Theſe

These approaches marked by the leetter *F.* being finished, and brought within one hundred yards of the *Contre escarpe* of the besieged; the Plat-forms (*c*) are to bee raised, marked by the letters *E.* and 4 or 6 Demi-Cannons to bee placed and pointed against the flanks of the Bastions, and the brest-works of the Rampiars; to batter to dust all the brest-works of the Flanks, and Rampiars. And while this is a doing, some of the Pioniers are to work day and night in the private approaches under ground, (*d*) to break into the *Contre escarp*; and some other Pioniers in the night time are to work about the begerting circulary trenches, (but if the Army be provided with mantlets, they may also work about this trench in the day time) that is, to goe round about the Garrison, marked by the letter *O.* that is, to have spaces left to place Turn-pikes to sally forth, when the secret approaches are almost finished, to assaile the *Contre escarpe*, while these that are in the approaches under ground, break into the *Contre escarpe*, and by a furious onset inforce the Defendants to retreat into the Garrison, and to forsake the *Contre escarpe*.

(*c*) The fift operation.

(*d*) The sixt operation.

The *Contre escarpe* being won, and the circulary (*e*) trench finished, the Peeces or Demi-Cannons, that were appointed to beat down the brest-works of the Flanks and Rampiars, are to be removed as soon as other Plate-forms (*f*) are raised upon the *Contre escarp*, to place and point some of them against the Points of the Bastions that are intended to be stormed; and the other against the flanks that may be repaired that way, that they may erect their (*g*) Galleries over the Mote, if it be full of water: or if it be drye, to fill the same in a night with Bavins, that the Pioniers may begin their Mines, to blow up some part of the Bastions; but because the ensuing operations are demonstrated in the next plate, I will here describe the *Ichnography* of this intrenched Camp with the dimensions of all the parts of it, and will referre you for the rest to the next Chapter.

(*e*) When this circulary line is finished, the defendants can by no meanes sally forth any more.

(*f*) The seventh operation.

(*g*) The erecting of Galleries, is the eight operation.

The Ichnography of the 24 Plate.

A. Represents the Garrison besieged of a Sexagon form fortified by six Bastions, with Orillons; after the best *Italian* Method,

thod, as may be seene in the next Plate.

B. Represents the foure quarters of the Army, that contain in their circumference a mile and a half, and may contain three thousand Foot and a thousand Horse a piece.

C. Represents the double Line of Communication that conjoyn the foure quarters one with another; the circumference of the whole Camp, with the foure quarters, is in all of eight English miles; and the distance from the end-side of the Camp to the Contre escarpe of the Defendants, is of five eight parts of a mile; and the distance from the broad side of the Camp is of seven eight parts of an English mile, and thereby free in all parts from the besieged Garrison Cannon shot.

D. Represents the winding approaches that runne to the begirting trench, the earth of which is cast toward the Town, to serve as a breast-work to the assailants, to cover them from the Musquet shot of the Defendants that are in the Contre escarpe; the earth of the winding approaches is cast some at the right hand, and some at the left hand, the better to preserve them that goe, or are in them; their ditches are represented by the white lines, and their banks by the thatcht lines; their banks are so high, that neither Foot nor Horsemen can be in danger of the Cannon or Musquet shot of the Defendants. The breast of their flanks placed upon every winding angle, are of seventy yards broad apiece; that they may contain 40 or 50 Musquetiers apiece, if need require.

E. Represents the foure first plat-formes for to raise Battery; these batteries are to be raised according to the seat of the place; if it be to batter the upper flanks of the breast-works of the Rampiars, they need not to be above two yards high; if it be to batter the lower flanks, and the faces or points of the Bastions, and the foot of the Rampiar, they are to be 4. yards high, and sometimes more. They are alwayes to be intrenched round, but in one place, where the barrier is placed with a good ditch, and a breast-work well flanked, and to contain between 60 or 100 Musquetiers, and Pike-men, and Holbardiers, to preserve the Peeces, if in case the Defendants made a great and strong sallie.

F. Represents the Flankers placed at every winding Angle of

the approaches; their breſt is from 70 yards to 80, and may contain 40 or 50 Muſquetiers.

G. Repreſents the Diagonall approaches of the broad ſides of the Camp, that croſſe one another like a traverſe, of which we have not ſpoken at all, becauſe the batteries were not of that ſide; but what hath been ſaid of the other, will alſoſerve for them.

H. Repreſents all the flanks of the Diagonall approaches of the broad ſides of the Camp.

I. Repreſents the upper traverſe of the Diagonall approaches, and a ſmall halfe moone that defends the comming in of the ſaid traverſe.

K. Repreſents the lower traverſe of the Diagonall approaches; and the little halfe moones that defend the comming in and going out of the two great quarters of the two broad ſides of the Camp.

L. Repreſents the foure ſmall halfe moones that defend the comming in and the going out of the foure great quarters of the Camp, towards the fields. The ſides of theſe halfe moones are of 60 yards apiece.

M. Repreſents the road or covered way, that leadeth from one quarter to another, between the Lines of Communication: it is of 16 yards broad, beſides the thickneſſe of the two breaſt-works, and of their five foot-ſteps that are in the bottome eighteene foot, and at top ten foot, and of nine foot high , the ditches are eighteene foot broad and nine foot deep.

N. Repreſents the two plat-formes erected by the diagonall approaches on the broad ſides of the Camp.

O. Repreſents the begitting trench, and her flanks or breaſt-works.

P. Repreſents the turne-pikes and iſſues to goe to aſſaile the Defendants Contre eſcarpe.

Some will object, that to erect ſuch a Camp, it will be a tedious and a chargeable piece of work. But I anſwer, That an Army conſiſting of twelve thouſand Foot, will finiſh ſuch a Camp, and erect two ſuch bridges over a River, as broad as the Trent is before *Newarke*, in leſſe then a fortnights time,

ſo

ſo the Army be provided, as it ſhould alwayes be, with ſix thouſand pick-axes, ſpades, and ſhovels, and with foure hundred wheele, and hand-barrowes, and as many ſcuttles, and with ſtore of Carpenters. And for Pioniers there need none, ſo the Generall be pleaſed to allow foure pence a day to the Foot Soldiers of his Army, that will work when they are out of guard, over and above their pay. And theſe charges would be recovered one hundred fold, by the ſpeedy reducing of the Garriſon that is conſumed by the pay of an Army, that ſpins out the time in other methods of Sieges; and which is of more value, many hundred mens lives will be preſerved by this method of Sieges.

CHAP. XXXVI.

Of the Batteries erected, and of the Mines to be ſprung againſt a beſieged Garriſon, demonſtrated in Plate 25.

VPon theſe laſt opperations, depends the honour or diſparagement of the Aſſailants, and the preſervation or deſolation of the defendants, if they behave themſelves like men of Warre, or be daunted or diſmaid by the roring of the Cannons, and of the furious ſtormes of the Aſſailants. Now to deſcribe theſe effects that are the moſt dangerous and terrifying actions of the Art of Warre, I will in the firſt place ſet forth the Aſſailants duty, and ſecondly, the Defendants oppoſition.

The new batteries erected upon the Contre eſcarpe, that we ſpoke of in the laſt Chapter, marked with the letter *V.* in this Plate, appointed to beat, to ruine the two points of two Baſtions, are to have ſix whole Cannons mounted upon them, and pointed againſt the ſide of the face of the Baſtions, within twenty yards of the point, as the moſt convenient place, to make a ſpeedy breach, for to fill with the ruines of it the mote or ditch, theſe ſix Cannons are to be pointed,

diſcharged, and fired at one and the ſame inſtance of time, by ſix Cannoniers, and not one after another, allowing ſome intermiſſion of time, betweene the firing of them, as we commonly uſe to doe, but all at one clap, becauſe ſix Cannon ſhot comming at once againſt a Bulwarke, Rampiar, or Stone Tower, is more powerfull to ſhake and ruine the ſame, then forty ſingle Cannon ſhot, that are fired between ſome intermiſſion of time: And as ſoone as the ſix Cannons of one Battery have been fired, the other ſix Cannons of the other Battery pointed againſt the other face of the other bulwarke is to be fired, that there may be a continuall roring of the Cannons, that the beſieged may be the more amazed and perplexed, to which of theſe two breaches they ſhall firſt repaire, or bring materials to repaire them.

The other two batteries alſo, marked by the letter *R.* are to have three or foure whole Culverings upon them, that are to be pointed againſt the flanks of theſe two baſtions, that are alſo to bee fired one after another from every ſeverall batterie, but the foure culverings upon every one of them are to bee diſcharged and fired at one inſtant of time, as hath been formerly ſaid of the ſix Cannons. And ſo by theſe foure batteries, if they bee well ordered, there will bee a continuall Roring of th Cannon, with little or no intermiſſion at all; And theſe batteries are to continue till the breaches be ſufficient, and at the leaſt twenty yards broad, and levell with the ground, that twenty men may come out abreſt, as cloſe together as may be, and all the night time the aſſaillants from the Contre eſcarpe intrenchments, that they have made as neare the brim of the mote as may be, are to hinder (with freſh companies of Muſquetiers that are to be relieved at every change of the Centries) the defendants to repaire the breaches, that the generall aſſault may be given the next morning.

(*i*) The ninth operation.

But before theſe Batteries begin, the two (*i*) Mines marked by the letter *O.* are to be brought to ſuch a paſſe, as they may be ready to ſpring juſt in the midſt of theſe foure Cannon batteries, that there may be foure breaches in three of the baſtions of this Sexagon Garriſon, all at one time, to make

a

a diverſion of the Defendants forces; by which diverſion, their forces muſt of neceſſity be divided: and by conſequence weakned and diſinabled to make ſo ſtrong an oppoſition as they might doe, if there were but two breaches.

The beſt way to guide covered approaches or mines, to that very place you purpoſe to doe, is to have a perfect Sea-compaſſe with you, that you may note upon your Table-book, upon what point or degree the place you intend to come to, ſtandeth; from the mouth, or opening of the covered approaches, or mine.

This mouth or opening, is to be made eight or nine foot ſquare, and the bottome as deep as you intend to goe with your Mine, (*k*) then you are to ſet your Sea-compaſſe (*l*) upon the point or degree noted before, and to order the Pioniers to mine juſt upon the ray of the degree; their way is not to be, if the ground permit above four, or four foot and a half broad, and not above five, or five foot and a halfe high, that two men may conveniently paſſe with * hoddes on their backs full of the earth of the myne; that is, to be brought up from the mouth of the myne with a Ladder, and placed ſome ſixteen foot from the brim of the mouth; in manner of a ſquare breſt-work, as it is demonſtrated in this Plate by the letter *N.* the letter *M.* repreſenting the mouth of the myne. But this method is to be onely obſerved, if in caſe the mouth be in the field, as the mouth of all covered approaches are; but if the mouth of the myne doth begin beyond the mote, then the earth is to be beſtowed to raiſe the banks of the ſmall intrenchment that are made along the wall of the Rampiar.

(*k*) The true way how to begin a Mine.

(*l*) Sea-compaſſe is of neceſſity to be uſed in the ſetting out of Mines.

* Theſe hods are great baſkets pointed in the bottome, and two foot broad at top, flat againſt the backs, and round without ſide; wherein a man may carry three times as much earth as in a Scuttell.

Now when the Pioniers have entred the mine ſome foure foot, you are to ſet up at the entrance of it ſuch a ſtrong doore caſe, as is marked by the letter *T.* having two ſtrong ledges nayled two inches and a halfe lower then the very top; and at every ſix foot of the way of the myne, you are to place ſuch another doore-caſe, and to ſet planks of two inches and a halfe thick upon theſe ledges ſpoken of before; and this muſt of neceſſity bee done, where you find the earth to bee apt to calve: but where it is ſound, this charge may be ſpared.

(*m*) How to hold up the earth of a Mine from calving in.

And when the way of the Mine is come so farre under the face of the Bastion, as you desire; you are then to wind the way of your Mine ten yards on the right hand, and ten yards on the left hand; in the manner of a *T*. as it is demonstrated in this Plate, and to make two round Ovens of that capacity, to contain six or seven barrels of powder apeece; as it is demonstrated by the letter *P*. and when these barrels are placed in both Ovens, the mouth of them is to be stopped (after the Traine of powder to them, hath bin laid upon boards) with (*n*) bricks and lime, with a hole in the bottome of foure inches square, for the Traine to be brought along the way of the Mine to the very mouth of it. Others make use of a copper pipe made like a *T*. in which they put a fine tinder match; the burning of which, they have made experience of, to know the just time that it will require to burne, to set the Train close to the powder barrels on fire, and do set the other end towards the mouth of the Mine on fire, so many houres before the time they intend to spring the Mine; the other way by a Train upon boards to the very mouth of the Mine is to be fired with a lighted match, fastned to the end of a long kane; and he that fireth the same, is to run aside as farre as he can, to avoyd the danger of the splits of the Mine.

(*n*) All other kind of stoping the ovens' mouth, is nothing to bricks and lyme.

These two Mines being sprung at the same time, that the breaches of the Cannon batteries are ready for a generall assault, will produce a great amazement, or a panique feare among the Defendants. And upon this amazement, the Regiments that are appointed to attempt every one of these severall breaches, are to be ready, and to advance furiously (*o*) forward to enter the breach; for to crowne their heads with the Crown of Lawrell, due to the Victors. But because most of our souldiers goe not armed as they should, for such a dangerous and desperate attempt, I will here describe the Arms, that a wise Generall, that holds the lives of his souldiers more precious to him then his own, should have alwayes ready to preserve such valorous souldiers, that lead the way to such a Feast; he is I say to have alwayes one hundred of brest-plates, and one hundred of head-peeces, and one hundred of Roudaches, or broad Targets of musket proofe, to dispose among those that undertake to lead the

(*o*) The tenth and last operation of the Assailants, to obtain and reduce a Garrison Town.

the Front of the three firſt ranks that enter theſe breaches, and this would preſerve many mens lives, and make them goe on more boldly to ſo dangerous a fight.

In the next place we are to ſuppoſe that the Aſſailants by their valour have entred the breaches, and obtained the points of the Baſtions, and other the top of the Rampiars; and yet cannot enter the towne, becauſe of the provident fore-caſt of the Defendants, that have intrenched themſelves between the town and their Rampiars, and overthwart the breſt of the Baſtions: yet the Aſſailants are not to be diſcouraged, but preſently caſt up ſome ſmall trenches upon the Rampiars, and the points of the Baſtions they have taken, till their ſmalleſt Sacres and Drakes be drawn up upon the Rampiars, and the points of the Baſtions, that will ſpeedily beat the Defendants from their weak intrenchments, and inforce them to a parley, having then no other meanes left to preſerve their lives but that; for if they be forced by another ſtorme, they are like to ſuffer all the miſeries that a provoked and incenſed enemy, will be able to inflict upon them.

But ſuppoſe that the Aſſailants be repulſed with great loſſe from the firſt and ſecond Aſſault, yet if the Generall can beare theſe loſſes patiently, being intrenched in ſuch a manner as is afore ſaid; he may reduce in few dayes this obſtinate Garriſon, and obtaine the Crown of Lawrell, due to ſuch as are conſtant in their warlike attempts, by famine, that inforceth the greateſt reſolution, to an accommodation. For if he can but endure the irkſome and tedious labour of a long ſiege, this Garriſon notwithſtanding this great reſolution, can hope for no reliefe. For if a greater Army then his come to endeavour to raiſe the ſiege, it cannot force this intrenched Camp, nor inforce him to battell, except he liſt himſelfe, or that ſome apparent occaſion of prevailing ſhould be offered; as the wearineſſe of the *Gaules*, did induce *Cæſar* to ſally out of his intrenched Camp, after they had tired themſelves upon their vain attempt, to break through his ſtrong Rampiars and intrenchments, otherwiſe it would be no wiſdome for a Generall to embrace an uncertain enterpriſe, for a certain victory, that cannot be taken out of his hands, if

See *Cæſars* Commentaries *lib.* 7.

if he continue in his intrenched Camp; for at last that Garrison will be inforced to yield to his mercy, as the City of *Alexie* was constrained to submit to *Cæsars* clemency.

Having fully shewn the endeavonrs and the valour of the Assailants, it remaines for the conclusion of this point, and of this abstract, to shew also the endeavours that a valiant and prudent Governour is to perform, to discharge with a good conscience the great trust that hath been reposed upon him, for the defence of such a Garrison. First, as the Assailants erect their batteries, and point their Cannons to beat down the brest-works of the flanks, and of the Rampiars; he is to indeavour to hinder the raising of these batteries, or to dismount their Cannons by placing the greatest pieces he hath, upon the Mounts or Cavalliers that are erected near to the middle of the Courtines of his Garrison.

The ten opperations for opposition.

2. He is to have great care to cause the brest-works of the Flanks, or of the Rampiars, that have been beaten down in the day time to be repaired in the night; causing women and children to bring earth in the day near unto the places of the greatest breaches, that may with the more speed be repaired, having alwayes many hoppes and wool-sacks in a readinesse to serve as brest-works upon the breaches of the Rampiars, and of the Bulwarks.

3. He is to charge the Inhabitants to bring store of fewel and their greatest Caldrons, or Kittles to the houses adjacent, to the Rampiars, and to command that store of oyle, and water may be in a readinesse: that in the time of the generall assault, fires may be kindled near to the Rampiars; and oyle and water heated boyling hot in these Cauldrons and Kittles, to be thrown by the women upon the Assailants that endeavour to scale the Rampiars.

4. He is to have great store of all manner of fire-works ready to cast upon those that endeavour to enter the breaches, to dismay and offend the assailants, placing many musketiers on both sides of the breaches, that may gall the assailants in the flanks.

5. He is to have in the Magazine of his Garrison, one hundred of Sea-Muskets, that the French call *Harquebus à Croch*, that

that carry a bullet three times as great as an ordinary Musquet, and longer then they by halfe a yard, and one hundred of Roudaches, or iron targets of Musquet proofe, and one hundred of Partisans, and as many good Halberds, with a hundred of breast-plates, and as many head-pieces, all of them of Musquet shot proofe: and all these are to be disposed to the most valiant soldiers of the Garrison, that dare undertake to defend the breaches.

6. As soone as he perceiveth that the assailants erect their batteries, he may presently guesse where they intend to make the breaches; then is he to take order, to erect by times new intrenchments, for it is too late to goe about them, when the assailants have gotten the rampiars, and the points of the Bulworkes.

7. When the Assailants begin their Mines, he is diligently to search the place where they intend to carry their mine; and because they seeme sometime to goe one way, when they intend to goe another, to delude the defendants, he is to try in all places that he may mistrust they intend to goe with their Mines, these conclusions:

Let a very thinne Barbers bason be set to that place that is suspected, full of cleare water; If the Assailants mine in that place, at every stroke of their pick-axes, the water in the bason will frizzle into small round circles, as if a small stone were cast in a paile of water.

Or let a drumme be set downe to the place, and some very round white pease be set upon the top of the drumme, and these pease will leap at every stroke of the assailants pick-axes, if they be mining in that place. And if any of these symptomes appeare, then is he suddenly to set Pioniers at work, to countermine, and to give aire or vent to the assailants mines; and when the defendants Pioniers come neare their Mine, let them proceed no farther, but let the Centries that are neare the place, where the mouth of the assailants mine is, give intelligence from time to time, if any barrells of powder be brought into the ovens of the Assailants mine; for before they can fire the same, the defendants may if they be vigilant, de-

prive them of their powder, and all's under one, give vent to their Mine. This ſtratagem hath been ſucceſſefull to divers defendants.

8. When the aſſailants endeavour to carry over their galleries over the mote, he is then to ſpare no paines to place Muſquetiers on their flanks to impede them; but if in caſe they are covered from the Muſquet ſhot by mantlets, he is then to have the Demy-cannons placed in the lower flanks of the baſtions, to be ſuddenly charged with iron balls, (and the caſe-ſhot wherewith they were charged before, removed, that as ſoone as the aſſailants galleries are almoſt brought over) the ſhot of theſe two Demi-cannons may break them to pieces.

9. The Demi-cannons that are placed in the upper flanks, are to be charged with chaine ſhot, that is, with two iron balls linked together by an iron chaine, that when the generall aſſault is given, if in caſe the aſſailants ſhould attempt to ſcale the Rampiars, the ſaid chained balls might caſt downe all their ſcaling ladders.

10. And laſtly, the Governour during the ſiege is to double his Courts of Guards, and Centries, and to goe the Rounds oftentimes himſelfe, and in the day of a generall aſſault, he is to goe to all places, and to view the defects, and to apply remedies to them, ſending ſudden reliefe to thoſe breaches that are in moſt danger to be entred, and to have alwayes about him, ſome three ſcore of the moſt valiant ſoldiers of the Garriſon, being in the head of them, to relieve the moſt diſtreſſed place of the Garriſon: and by theſe and ſuch like endeavours of valour and fidelity, he is to diſcharge the truſt repoſed upon him, and preſerve his Garriſon, if it be poſſible.

Here followeth the Iehnographie of the dimenſions of the Fortifications of the Garriſon beſieged, demonſtrated in Plate 25.

A. Repreſents the Garriſon reduced into a Sexagon forme; the ſides of it are according to the beſt Italian Methode; divided firſt into tenne equall parts; foure of which are allowed for the two demy gorges, and the other ſix for the Courtine,

and

and theſe ſides are of 250 yards apiece.

B. Repreſents the whole gorge, that is of 100 yards.

C. Repreſents the demi-gorge, that is of 50 yards.

D. Repreſents the diſtance from the centre of the Baſtion, to the utmoſt point or angle of it, that is of 100 yards.

E. Repreſents the face of the baſtion that is of 120 yards.

G. Repreſents the circulary compaſſe of the Orillons that jet beyond the ſhoulder 20 yards.

H. Repreſents the breaſt of the Baſtion that is of 120 yards.

K. Repreſents the Courtine that is of 150 yards, that is divided into 8 equall parts; from the firſt part of which, the line of Defence is taken, according to the Italian method, that is, 14 yards nearer the flanks, then the Hollanders take it.

L. Repreſents the line of defence that is of 240 yards.

M. Repreſents the mouth of the Mine.

N. Repreſents the earth of the Mine, placed in the manner of a breaſt-work.

O. Repreſents the way of the Mine under-ground.

P. Repreſents the two ovens of the Mine.

Q. Repreſents the Copper-pipe, in which they ſet the tinder, match, wherewith the traine of the Mine is fired.

R. Repreſents the two ſmalleſt plat-formes.

S. Repreſents the winding approaches, whereby they come to the ſmaller plat-formes.

T. Repreſents the two door-caſes, to ſupport the earth of the mine

V. Repreſents the two great plat-formes.

F I N I S.

ERRATA.

Page 4. *line* 2. *for* higher *read* higheſt. *p.* 9. *l.* 32. *for* another, *r.* by another method. *p.* 25. *l.* 4. *for* ſquare, *r.* baſe or ſide. *p.* 25. *l.* 11. *for* ſet out, *r.* ſet it out. *p.* 32. *l.* 17. *for* but one, *r.* but of one, &c. *p.* 61. *l.* 5. *for* ſlope nothing, *r.* ſlope to nothing. *p.* 75. *l.* 15. *for* ſtep, *r.* ſlope. *p.* 87. *l.* 4. *for* ſtake *r.* take. *p.* 88. *l.* 12. *for* rod, *r.* rode. *p.* 92. *l.* 28. *for* rover. *r.* roarer. *p.* 101. in the Annotations, *for* du Belluy, *r.* du Belay. *p.* 110. *l.* 33. *for* Planks or gravell, *r.* and gravell. *p.* 111. *l.* 7. *for* bottomed, *r.* homed.